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RESEARCH ARTICLE

The use of attractants in the application of food-baits against termites

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Abstract

The article presents the results of scientific research on the identification of attractants in the development of food-baits against termites of the genus *Anacanthotermes*.

Keywords

Termites, feed, attractants, strenal gland, plant extract

Introduction

Nowadays, significant changes have occurred in the structure, composition and number of bio-polluting organisms in buildings and structures due to the growth of anthropogenic factors around the world. In particular, due to the excellent adaptability properties of termites, it leads to their entry from natural habitats into urban areas. Damage from termites is extremely high, especially in densely populated countries with relatively hot climates. Accordingly, it is important to develop modern control methods to control the number of termites in areas with strong anthropogenic pressure (Amburgey et al. 1981; Ganieva et al. 2019a; Ganieva et al. 2019b).

Throughout the world, attention is being paid to the use of termites in order to avoid the treatment of wooden equipment of buildings and structures with toxic drugs through the rational application of the biological properties of termites. In this regard, the measures are being taken, such as the use of molecular-genetic methods in the differentiation of termite species, the study of intestinal symbionts, the development of methods of control using juvenile hormones that control the process of metamorphosis in these insects (Khamraev et al. 2009; Khamraev et al. 2015; Kholmatov et al. 2018).

It should be noted that today termites are a pest that causes unprecedented damage in Central Asian countries, including most parts of the country, causing severe damage to residential buildings, historical and cultural monuments, wooden construction materials. In Uzbekistan, the Turkestan termite *Anacanthotermes* (*Anacanthotermes turkestanicus* Jacobs, 1904) and the Great Trans-Caspian termite (*A. ahngerianus* Jacobs, 1904) have been identified, they are currently causing serious damage to wooden structures and other materials in the territory of our country, residential buildings, historical and cultural monuments and strategic objects (Khamraev et al. 2009).

Despite a number of measures being taken today to manage the number of termite populations, their range is expanding. Historical monuments, dwellings and buildings made of traditional wooden planks are particularly hard hit by termites. According to the latest data, termite damage has been recorded in more than 15,000 households in the country (Ganieva et al. 2019a; Ganieva et al. 2019b; Khamraev et al. 2009; Khamraev et al. 2015). At the same time, the damage to historical monuments and buildings is also of great concern.

Yet the biological and ecological characteristics of termites have been studied in some regions of the country, methods and means of preventing and eradicating them have been developed at different times, it is noted that termites occupy more space, and that existing control tools are not effective enough. Therefore, given that the lifestyle of the termites of the *Anacanthotermes* generation has not been fully studied, the proposed methods and tools are not effective enough, or the proposed basic chemicals have been withdrawn from production due to strong adverse effects on humans, warm-blooded animals and the environment, in the fight against termites, there is also a need to develop new methods of rational use of environmentally friendly, improved, highly effective new feeds and other means of control in the world market, because they can be both an effective and cost-effective tool in an integrated system of termite control (Amburgey et al. 1981; Khamraev et al. 2015].

Given the growing threat of termites in the country, after 2000 the Republic of Uzbekistan paid attention to this problem at the national level, and in accordance with the Resolution of the Cabinet of Ministers of February 2, 2012, No 27, the Republican Center for Termite Control was established at the Institute of Zoology. One of the priorities of the center is the production of poisonous food-baits against termites and pesticides, as well as the development of recommendations and guidelines for the fight against termites in collaboration with scientists from the Institute

of Zoology. In response, a method of preparation of insecticides against termites was developed, on the technology of application against termites, "Cylindrical container" – UZ № SAP01243 (02.08.2013) and "Device for eradication of termites of the genus *Anacantothermes*" – UZ № FAP00954 14.06.2013) received a patent for a utility model, as well as a patent for the invention № IAP 05832 "Method of preparation of insecticides against termites" dated May 8, 2019 was gained and the patent-based feed-bait is widely used in termite control systems.

However, in the hot climate of Uzbekistan, there are some shortcomings in the use and effectiveness of this feed-baits. We know that termites of the genus *Anacanthotermes* are characterized by a constant tendency to moisture, and the attractiveness of this feed-baits depends on the fact that it retains its moisture, requiring constant spraying with water at hot air temperatures. Even if termites eat at least 25% of the food-baits, the efficiency will increase to 85–90%, but the problem is that in most cases the termites will not be able to find food. Therefore, in order to improve the toxic feed-baits in use today, there is a need to increase the attractiveness of the feed-baits, including the addition of flavoring and moisture-retaining additives in a form that prevents the development of harmful microflora during long-term storage. It is necessary to develop the packaging and ensure the convenience of delivery of feed-baits. This leads to an increase in the biological efficiency and duration of exposure of the feed-baits, which in turn plays an important practical role in the control of termites of the genus *Anacanthotermes*. In view of the above, a number of research studies have been conducted in this regard.

Materials and methods

Experiments of laboratory

As a biomaterial (termites of different layers) for laboratory research, indeed, mainly imago, soldier and working termite classes of different ages were imported from the Republic of Karakalpakstan, Khorezm, Syrdarya and Jizzakh regions in 2018-2020. Furthermore, a termite nest was brought from the Shibili ota shrine in Kegeyli district of the Republic of Karakalpakstan and was installed in an artificial termite nest. The research was conducted at the Institute of Zoology, Academy of Sciences of the Republic of Uzbekistan, in the laboratory of the "Theoretical foundations of entomophagous ecology and biomethods" and in the State Unitary Enterprise "Republican Center for Termite Control" at the Institute.

In the development of new "Antitermite" food-baits, researches were carried out on the development of prophylactic, ie antiseptic substances that attract termites (attractant), taste better and are repellent and killing (termitocid). These researches were carried out in the laboratory on the basis of methods N.M. Trushenkova (1962), N.B. Belyaeva (2004).

Also, the study of the properties of the action of antimicrobial and thermocidal agents was carried out on the basis of generally accepted methods (Belyaeva et al. 1984; Kakaliev 1966; Marechek 1976; Trushenkova 1962).

In order to do this:

In determining the attractive properties of substances of different composition: *Ferula*, soil from termite nests and plants found in the hive were crushed, placed in glass jars and poured into it 10 ml of hexane, and kept in the dark for 24 hours. After one day, the above solutions were soaked in filter paper (2x2 cm), dried and given to termites as a food.

Five ml of synthetic pheromone synthesized on the basis of termites sterile gland by the laboratory "Chemistry of alkaloids" of the Institute of Plant Chemistry of the Academy of Sciences of Uzbekistan was brought, 1 ml of synthetic pheromone was dissolved in 50 ml of alcohol. In the following options; it was dissolved in alcohol in a ratio of 1:1 and 1:4, then was soaked in filter paper, which termites feed on.

Thus, extracts from various organs of the plant *Hultemia persica*, which is the most common plant around the termite nest, a synthetic pheromone, extracts of *Ferula*, as well as the trophic layer in the termite nest and the hexane solution of the plants in the termite nest feeding chamber were tested.

Experimental scheme:

1. 0,1 ml + 5 ml alcohol – 100 mg/ml
2. 1:1–2 ml +2 ml alcohol – 50 mg/ml
3. 1:4 – 1 ml +4 ml – 25 mg/ml
4. Control – water.

The following method was used: pieces of nests with termites inside, without damaging the galleries from the natural nests of termites were placed on the front of the rectangular plastic containers with a diameter of 30x65. The tested substances, as well as filter paper soaked in water (special form) were placed on the opposite side at a distance of 25 cm. The container was covered with a damp cloth to create a favorable microclimate for termites. Fabrics and filter papers were moistened daily and the arrival of termites in the food was monitored.

Result

Based on the information by the locals that termites build nests in the presence of *Hultemia persica*, the flowers, stems and roots of the termites were brought to the laboratory from the biocenoses where termites were common, and their attraction properties to various termites were studied (Fig. 1).

In order to increase the attractiveness of the termite in the creation of a new feed "Antitermite", the attraction properties of various substances to termites were tested, taking into account the specific food storage properties of termites. (Fig.2). The behavior of the termites in the experiment was also continuously monitored during the study.

Thus, according to the results of the study:

Termites actively consumed the food (85%), which was soaked in the extract from the flower of the plant *Hultemia persica*.

It was found that on average, termites came to the food, which was soaked in the trophic layer extract and consumed it (75%).

It was found that termites also came to the food soaked in the food extract soaked in the food chamber and were consumed by them (75%).

It was found that termites also came to the food soaked in Ferula plant extract and were consumed by them (75%).

It was observed that termites feed on the most abundant (85%) of the soaked food extracted from the flower of the Persian hultemia, *Hultemia persica* plant.

Termites did not come as actively to the feed soaked in the extract obtained from the stem of the Persian hultemia, *Hultemia persica*, i.e., more than the control, consumed less than in the above tests (50%).

Figure 1. Plant *Hultemia persica*, nesting and mud wrapping of termites around this plant in natural areas.

Synthetic pheromone extract based on strenal glands was not consumed daily (10-15%) due to its low attraction properties, in addition, termites died from the food soaked in this extract.

Thus, the attractive properties of substances of different composition in relation to termites decrease in the following order: Flower of the *Hultemia persica* > trophic layer; food in the chamber> *Ferula* plant>Stem of the *Hultemia persica* > Sterinal gland pheromone (Table 1).

Table 1. Attractive properties of substances of different composition in relation to *Anacantothermes ahngerianus* termites

Substances tested for attractiveness	Indicator of termite attraction in control (distilled water) %	Indicators of termite attraction of extracts of substances in the experiment %
Chamber № 1. The flower of *Hultemia persica*	15%	85%
Chamber № 2. Trophic layer	25%	75%
Chamber №3. Foods in the food chamber	25%	75%
Chamber № 4. Plant *Ferula*	25%	75%
Chamber № 5. Stem of *Hultemia persica*	50%	50%
Sterinal gland pheromone	65%	15%

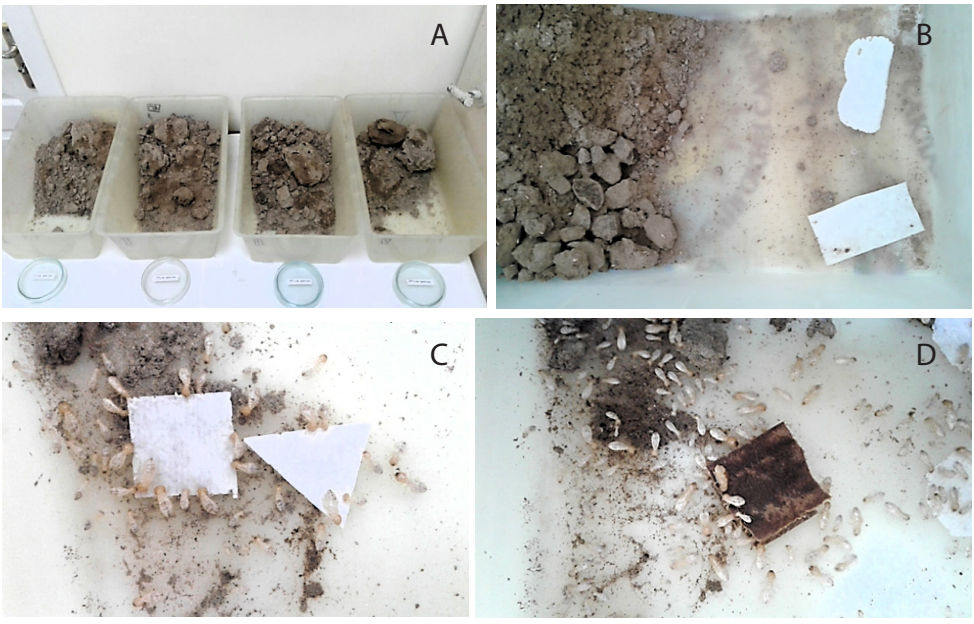

Figure 2. Laboratory experiments to study the attraction properties of substances of different compositions to termites: **A** – pre-experimental training; **B** – rectangular filter paper soaked in synthetic pheromone extract based on strenal gland and crescent-shaped filter paper soaked in ordinary distilled water; **C** – rectangular filter paper soaked in the extract from the flower of the plant *Hultemia persica* and ordinary distilled water soaked triangular filter paper; **D** – post-experimental cases when termites have completely eaten the filter papers.

The results of this laboratory study show that the highest value was observed in the flower of *Hultemia persica*, while the lowest value was observed in the Sterinal gland pheromone of termites. Many years of research on termites have shown that both world experience and experiments conducted in the entomology laboratory in the 2000s (Kakaliev 1966) showed that the sterinal gland pheromone of termites has a high attractiveness for termites.

The high attraction of *Hultemia Persica* is a completely new indicator, based on the information of the locals that a termite nest was found in the place where this plant grew, which proved that this plant has a high attraction to termites.

Furthermore, to improve the "Antitermite" food-baits and determine its attractive properties: termites were observed to consume a solution of *Ferula* plant, soil from termite nests and plant residues found in the nest in hexane during a day, and when a solution of the above substances was soaked in filter paper to feed the termites as food to determine their effect, they consumed *Ferula* plant extract well. They did not consume the filter paper soaked in the soil- extract from the termite hive at all, and consumed a small amount of the hexane extract of the plant residue found in the hive.

Conclusions

According to the results of laboratory studies to determine the attractive properties of substances of different composition in relation to termites of the genus *Anacanthoterme*, the following conclusions were drawn:

1. The highest attraction features was observed in the flower of *Hultemia persica*, while the lowest indicator was observed in the Sterinal gland pheromone of termites.
2. Attractive properties of substances of different composition in relation to termites decrease in the following order: Flower of the *Hultemia persica* > trophic layer; food in the chamber> *Ferula* plant> Stem of the *Hultemia persica* > Sterinal gland pheromone
3. In the future, in order to increase the attractiveness of the new "Antitermite" food-bait, it is recommended to use the extract of the flower of the most common local plant around termite nests – *Hultemia persica*.

Based on the above, in enhancing the attractiveness of the “antitermite” food-baits and any future termite food-baits, it is recommended to use the extract of the flower of the native plant *Hultemia persica*, which is the most common around termite nests and has a high attraction features to termites. It should be noted that the studies also successfully passed the first field experiments. Thus, this ultimately serves as a key factor in the complete extinction of termite colonies as a result of the discovery of food baits, which are the main tool in the fight against termites of the genus *Anacanthotermes*, by termites themselves, and as they are consumed with

pleasure and toxic doses are received by termites through the process of chain feeding (trophollaxis), reaching out to members of their underground colonies.

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