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Lethal Effect of Turkısh Dıatomaceous Earth (Bgn-1) agaınst Adults of German Cockroaches (*Blatella Germanıca* L.)

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In this study, mortality effects of BGN-1 which is local diatomaceous earths, were investigated against adults of German cockroach (*Blatella gemanica* (L.)) on concrete, ceramic floor tile and laminate flooring. On these three different surfaces, *B. germanica* adults were exposed to BGN-1 diatomaceous earth at the doses of 2.5, 5, 10, 20 g/m^2 along 6 days. In all surface applications of BGN-1 diatomaceous earth, exposure time and dose caused significant effect on mortality rates of *B. germanica* adults. It was determined that BGN-1 coded Turkish diatomaceous earth has the lowest mortality effect on all application surfaces at the dose of 2.5 g/m^2. 2.5 g/m^2 BGN-1 caused 100 % mortality after 6 days concrete surface and caused 100 % mortality at the end of the fourth day on ceramic floor tile and laminate flooring. On the other hand, doses of 5 and 10 g/m^2 of BGN-1 caused 100% *B. germanica* mortality on all surfaces at the end of the second day, while the highest dose of 20 g /m^2 of BGN-1 reached 100% *B. germanica* mortality at the end of the first day on all application surfaces. In general, the mortality activity of BGN-1 diatomites against *B. germanica* adults was found to be similar on all three surfaces. At the end of this study, local diatomaceous earth coded BGN-1 was found to be good alternatives for controlling *B. germanica* which is a medical pest insect.

Keywords: Turkish diatomaceous earth, *Blatella germanica*, surface application.

Introduction

The German cockroach is commonly found living area with people and scattered all over the world. It is also a major carriers of pathogens and main source of allergens. Therefore it is an important primary medical and economical insect pest. The cockroach is mainly controlled by synthetic insecticides (Rust et al., 1993). However, this cockroach widely developed resistance to these insecticides (Jialin et al., 2007). Hence, the development of new types of selective cockroach-control alternatives are needed.

Diatomaceous earth (DE) is a component of organic origin and is a precipitate formed from the fossilized siliceous shells of algae that have lived in all aquatic ecosystems. The cell walls of the algae are amorphous cystite (SiO2 + H2O). Recent studies have shown that DE has a significant impact on warehouse pests (Waksh and Shabbir, 2005; Athanassiou et al., 2007). In addition to the insecticidal effect of DE, it can be used as filtration, absorbant, filling material in the industry, silicon reinforcing in humans, and as a moisture retainer in the packaging of nutrients (Durmuşkaya, 2009). Diatomaceous earth is probably the most effective of the natural powders that can be used as insecticides. The insecticidal effect of diatomaceous earth is regarded as a method of physical struggle because it does not have a chemical effect on insects. This physical struggle; DE has an effect on the insect cuticle and results in death of the insect's water loss (Ebeling, 1971). DE, besides its water absorber feature, can also abrade the oil quite well. For this reason it is also very effective on the protective waxy layer present on the insect cuticle. As a result, death in insects occurs due to water loss and drying (Cloarec et al., 1992).

Furthermore, the killing effect of insects may vary significantly depending on the test conditions used, the diathermy (marine or freshwater diatoms), the geographical area taken, the formulation process, the oil absorption capacity and the chemical / mechanical modification of the diatomaceous earths (Faulde ve ark., 2006). Therefore, in this study, mortality effects of BGN-1 which is local diatomaceous earths, were investigated against adults of German cockroach (*Blatella gemanica* (L.)) on concrete, ceramic floor tile and laminate flooring.

Materials and Methods

Insect

Colonies of *B. germanica* were reared in plastic containers (60 liter) and maintained at room temperature. The cockroaches were provided with water in glass tubes with cotton stoppers and dry dog food. Each container was provided with paper egg cartons as shelter. The adult cockroaches (5-10 days old) were tested for each bioassays at 25 (± 2) ºC and 50 (±5) % relatıve humidity.

Local diatoms used in biological tests:

In this study, BGN-1 coded local diatoms from Kayseri/Turkey province were used. At least 5 kg samples were taken from the diatom reserve. The samples were mixed in the gutters and brought to the laboratory. The diatom specimen brought in rock form is prepared in natural form. For natural (natural) preparation of the diatom specimen, it was dried at 100 ± 10 ° C for 2 hours, until it had a 3-5% moisture content in a controllable ventilated oven. After drying, the small pieces were grinded in a laboratory mill for 10 seconds at the highest speed. All samples were then sieved through a 100 mesh (149 µm) standard sieve and the damp, soft small pieces left under the sieve were dried in a ventilated oven at 40 ° C for 24 hours. Thus, natural powdered diatomaceous earth of a particle size of 149 microns or less is obtained.

Surfaces used in biological tests

During the test, concrete, ceramic, parquet surfaces were prepared in plastic boxes (100x100x60 mm) and ventilation holes were opened with the help of a needle to the cover parts of plastic boxes in order to provide air in and out during the established tests.

Concrete Surface: The mortar obtained by using 200 g + 50 ml water was poured into plastic boxes (100x100x60 mm) and the mortar was obtained by drying.

Ceramic Substrate: The ceramic surfaces used during this work were produced from a mixture of clay, kaolin, quartz, feldspar and limestone in sizes of 150x150x5.5 mm according to TS202 standards. The ceramic surfaces produced in TS202 standards are reduced in dimensions of 100x100 mm and working dimensions are obtained.

Parquet Substrate: Laminated parcels which are manufactured according to the standards of High Density Fiberboard (HDF) and 717 E-1 are 8x195x1200 mm in size and 100x100 mm in size and working dimensions are obtained.

Biological tests and test method

Biological tests were carried out in the climate chamber with 25 ± 1 ° C and 65 ± 5% relative humidity. Water and feed were not given to insects during the experiment and insects were exposed to 2.5, 5, 10, 20 g / m2 doses of diatomaceous earth. Diatomaceous earth weighed with the aid of precision scales for dosing experiments is placed on concrete, ceramic and parquet surfaces. After the diatomaceous earth was distributed on the surface, ten newborn individuals from *B. germanica*, which we cultured in the laboratory environment, were left. The experiments were carried out in four replicates, with 10 individuals each time. The control unit was also set up in four replications and no diathermy was applied, such as water and feed. Dose experiments were taken into the climate chamber as soon as the establishment was established and dead-live insects were counted for six days. For the time trials, 6, 9, 12, 18, 24 hour experiments were set up as separate treatments, keeping the highest dose rate constant during the dose trials, thus setting up separate control units for each exposure period. The time experiments were carried out again with four repetitions and 10 individuals each time.

Conclusion

In all surface applications of BGN-1 diatomaceous earth, exposure time and dose caused significant effect on mortality rates of *B. germanica* adults. It was determined that BGN-1 coded Turkish diatomaceous earth has the lowest mortality effect on all application surfaces at the dose of 2.5 g/m^2. 2.5 g/m^2 BGN-1 caused 100 % mortality after 6 days concrete surface and caused 100 % mortality at the end of the fourth day on ceramic floor tile and laminate flooring. On the other hand, doses of 5 and 10 g/m^2 of BGN-1 caused 100% *B. germanica* mortality on all surfaces at the end of the second day, while the highest dose of 20 g /m^2 of BGN-1 reached 100% *B. germanica* mortality at the end of the first day on all application surfaces. The dose of 10 and 20 g / m^2 on the concrete surface of the native diatomaceous earth of BGN-1, which had been used in the experiment, had statistically similar effect on the concrete surface after 24 hours and was more effective than 2.5 and 5 g / m^2 doses. The BGN-1-coded native diatomaceous earth used in the experiment had the highest activity as a 20 g / m^2 dose statistically 24 h later on the parquet surface while it was found to have the lowest activity as 2.5 g / m^2 statistically. The dose of 10 g / m^2 was statistically found to have similar efficacy with both 5 g / m^2 and 20 g / m^2. The BGN-1-coded native diatomaceous earth used in the experiment had the highest activity as a 20 g / m ^{2} dose statistically 24 h on the ceramic surface and the lowest activity as 2.5 g / m^2 statistically. The dose of 10 g / m^2 was statistically found to have similar efficacy with both 5 g / m^2 and 20 g / m^2. In general, the mortality activity of BGN-1 diatomites against *B. germanica* adults was found to be similar on all three surfaces. The mortality rates obtained from *B. germanica* adults exposed to BGN-1-coded diatomaceous earth for a period of 6, 9, 12 hours for a dose of 20 g / m^2 are statistically similar. However, at the end of 18th hour mortality rate was the highest for concrete surface and reached to 100%, whereas parquet and ceramic surfaces were statistically similar. Mortality rates following 24-hour exposure were 100% for all surfaces. The mortality rate increases as the exposure time for all surfaces increases. In addition, exposure of the BGN-1 coded native diatomaceous earth to 20 g / m^2 for 18 hours resulted in 100% mortality for the concrete surface, while the other two surfaces reached 100% mortality after 24 hours.

All these results demonstrate that BGN-1 encoded native diatomaceous earth has potential for use in the B. germanica adult struggle and may be an alternative to synthetic instecticides with a broad-spectrum spectrum used in the struggle for this bug. However, diatom earth species should be demonstrated in a comprehensive study of the applicability of the German cockroach under natural habitat conditions and the determination of its interaction with other living factors outside cockroaches when applied in natural conditions.

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Efficacy of seven Turkish diatomaceous earths against *Callosobruchus maculatus* (F.) (Coleoptera: Chrysomelidae: Bruchninae) on stored chickpea

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Abstract

In this study, insecticidal efficacy of seven different local diatomaceous earths (DE) obtained from different deposits in Turkey together with two commercial DEs, Silicosec® (Biofa AG- Germany) and Desect® (Ep Naturals-America) against *Callosobruchus maculatus* (F.) (Coleoptera: Chrysomelidae: Bruchninae) an important pest of stored chickpea at five different concentrations (100, 300, 500, 1000 and 1500 ppm) was evaluated. The local DEs were coded as BGN, BHN, AG2N, AC2N, CB2N, CCN, FB2N. Mortality of the adults was assessed after 1, 3, 5 and 7 days of exposure, and consequently progeny (F1) production on treated chickpeas was recorded 42 days later. The tests were carried out under laboratory conditions of 25±1 °C, 55±5 % R.H. in a dark place. The most effective DEs after 1 day of exposure were CCN, AG2N and BHN causing 75%, 59%, 58% mortalities, respectively at 1500 ppm concentration. Silicosec®, Desect®, BGN, AC2N, applied at 1500 ppm concentration achieved 98-100% mortality of *C.maculatus* after 7 days of exposure, showing similar high insecticidal efficacy. The CCN, BHN, AG2N and CB2N caused 97-99% reduction in progeny (F1) production. Generally, increasing concentration significantly reduced the progeny production. In conclusion, this study has shown that three Turkish DEs, namelyCCN, AG2N and BHN highly toxic to *C. maculatus* after 3 days of exposurein comparison with commercial DEs Silicosec® and Desect®. These local DEs could be used in the management of pests of stored chickpea.

Keywords: Turkish diatomaceous earths, Silicosec®, Desect®, *Callosobruchus maculatus*, chickpea.

Introduction

Chickpea (*Cicer arietinum* L.) is one of the rare plants that have been cultivated since thousands of years and the Turkey's southeast region is known as the homeland of the crop. Globally, it is known that cowpea beetle, *Callosobruchus maculatus* (F.) is the most important pest of stored cowpea and other legumes (Taylor, 1981) and its origin is West Africa (Decelle, 1981). This insect can damage 100% of stored products causing weight losses of up to 60% (Tanzubil, 1991). Fumigants and contact insecticides have several problems such as development of resistance, chemical residues in food, as well as harmful effects on the environment and human health. Researchers are therefore searching for alternative methods of stored product protection. Diatomaceous Earths (DE) have less