

9. Various other arthropods

9.1 Determination of the lower lethal temperature of museum pests

Museum artefacts are in danger of becoming damaged by various insect pests e.g. larvae of Dermestids and clothes moths. Control of pests in museums is particularly difficult as pesticide application is avoided as a general policy in many Danish museums. Long-term pest control, on the other hand, is of paramount importance. Non-pesticide-based pest control is needed or wanted in a number of other situations, which means that research in this area can be of interest to a broader group of users e.g. store keepers and private persons.

Freeze disinfection is an attractive alternative control method and is applied in several museums. Based on existing information, freezing is conducted at temperatures below the super-cooling point of the pests, i.e. some times way below -20°C . This requires use of advanced and costly freezing equipment compared to a commercially available freezer. It is suggested that exposure of the insects to sub-zero temperatures above the super-cooling point can kill many pest species, thus involving lower investment and running expenses.

Initial investigations of this have thus been started. To mimic the conditions of a pest in a museum artefact, oak blocks, 20·20·20 cm with an internal cavity, have been manufactured. Insect test specimens and temperature monitors are placed in the block to determine the lower lethal temperature of the pests. Thermocouples are attached to some specimens to determine whether the super-cooling point of the insect species is passed. Investigations are planned with several Dermestid species.

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9.2 Coconut oil-based product for control of cockroaches and cat fleas

DPIL has evaluated a coconut oil-based product for control of cat fleas, *Ctenocephalides felis* (Bouche) and German cockroaches, *Blattella germanica* (L). The product was a commercially available 3.4% coconut oil product. Testing of the product was performed by topical application, residual tests and by spraying of insects. Water and pure coconut oil were used for comparison. Tween®20 was used as a detergent.

The topical application test was done by five replications with 10 cat fleas each. Five different volumes of the product were tested, and two series were conducted at 18°C and 26°C . At 18°C 100% control was obtained after 48 hours at a dose of 0.2 μl , whereas at 26°C 100% mortality was only obtained with a dose of 0.4 μl after 48 hours. The product was superior to water, water+tween and pure coconut oil as none of these reached 100% mortality. Pure coconut oil (0.4 μl) reached 50% control at 18°C and 56% control at 26°C , both after 48 hours. Similar tests with German cockroaches were conducted three times, each consisting of 4 volumes of the product tested on 120 male cockroaches. Based on these tests three LD_{50} were calculated 11.6, 13.8 and 15.1 μl product/cockroach, and the corresponding LD_{95} was 25.6, 29.9, and 73.4 μl product/cockroach. To evaluate the results we used nine cages containing 10 cockroaches each. All cockroaches were treated with 20 μl product, which resulted in a $88.2\pm 12.27\%$ mortality after 48 hours.

Testing of the efficacy of residuals on cat skin was evaluated by spraying of the fur on small pieces of cat skin. The recommended dose of 260 g/m^2 was used. Each test included three replications (10 fleas each), and all tests were repeated three times. Water was used as control. After the treatment anesthetized fleas were transferred to the fur while it was still wet. The result was as follows: mean percentage mortality on water-treated fur was $1.1\pm 0.03\%$ ($n=90$), and the mean percentage mortality on fur treated with the product was $7.8\pm 0.08\%$ ($n=90$). Data were evaluated after 48 hours of exposure. As it is demonstrated, no effect could be seen, and no effect could be detected, implying that the product has to be sprayed directly onto the insect to have an effect.

German cockroaches were exposed on treated plastic petri dishes. On low doses, cockroaches were moving freely in treated area, but at 400ml/m² and higher the product stayed liquid for 24 hours. Surfaces were treated 24 hours prior to exposure, and the cockroaches were then exposed for 1 hour. At 400 ml/m² the cockroaches were forced into contact with the product for an hour, but use of higher doses was abandoned. Three separate tests were conducted each with four doses and three replications per dose. The data were evaluated by a probit analysis and LD₉₅ were lying between 753 and 928 ml/m². Highest response was lying between 86.7 and 56.7% mortality. Close to 1 litre per m² is so high that it is very unrealistic for practical use as residual treatment.

The product was also tested against German cockroaches with the amount equivalent to one pump from a commercial pump sprayer. Five replications with ten cockroaches each were done on different surfaces i.e. glass, hardboard, vinyl. With the product, one pump was the equivalent of 56.3 to 64.1 g/m², whereas with water (used for control) it was 116 g/m³. The surfaces were left to dry for 24 hours after treatment. The cockroaches were exposed for 1 hour and then removed to new clean cages with food and water. The number of dead was observed after 24 and 48 hours. Neither of these tests demonstrated any effect on the cockroaches (48 hours: on glass 8.0%±8.4%, on hardboard 0.0%±0.0% vinyl 4.0%±5.5%, and on glass treated with water 0.0%±4.5% control).

One final trial was conducted with the German cockroaches in which they were sprayed with the product. One pump with the sprayer (ten repetitions) and two pumps with the sprayer (nine repetitions) were tested. Each repetition included ten cockroaches. One pump gave 97.0±22.7g product/m² and gave 19.0±17.3% mortality after 48 hours. Two pumps gave 168.5±32.1g product/m² and 74.4±20.1% mortality after 48 hours. These results show that approximately 200g product/m² sprayed directly onto the insect should be sufficient. This is equivalent to two-three pumps with a spray gun.

It can be concluded that both against cat fleas and against German cockroaches the product is effective when it is sprayed directly onto the insect, but it has to be studied in field trials as well. No residual effect could be identified against neither of the species.

Whether or not the product repels some insects has not yet been studied, but it is a possibility. It should be investigated as it is a relevant method for control of insects such as ants and mosquitoes.

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