Session 5

Physical and Biological Control

Temperature: Implications for Biology and Control of Stored-Product Insects

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Extended Abstract

Insects are affected by temperature in all aspects of their biology, ecology, reproduction, behaviour, physiology and biochemistry (Fields, 1992; Beckett et al., 2007). Stored-product insects reproduce between 15 and 35°C, with maximum reproduction occurring at approximately 33°C. Above and below these temperatures insects can move, but cannot complete their development. Temperatures below 5°C and above 40°C insects cannot walk, and will eventually die. Between -15 and -25°C insects freeze and die instantaneously. There are significant changes to these general patterns depending upon species, life stage and acclimation. For example, insects can become 10 times more resistant to cold if acclimated at cool temperatures (5-15°C) before being exposed to sub-zero temperatures.

Temperature also effects trapping (Fargo et al, 1989). The speed and direction of movement is affected by temperature (Flinn and Hagstrum, 1998). Insects move faster at higher temperatures, so that if the populations are the same, more insects will be trapped at higher temperatures. Insects will move towards warm temperatures, and avoid temperatures that are too hot.

In general insecticides work better at higher temperatures (Kenaga, 1961; Iordanou and Watters, 1969; Fig. 1), but some insecticides have only a small increase in efficacy (methyl bromide), others have a large increase in efficacy (carbon tetracholoride), whereas others have a decrease in efficacy (pyrethrins) with higher temperatures. Contact insecticides degrade faster at higher temperatures (Desmarchelier, 1977).

Given the many effects of temperature on every aspect of stored-product insects, researchers should carefully design experiments to avoid unseen effects by temperature, understand its effect on their area of study. Grain managers need also to be aware of the many ways, sometimes not obvious, that temperature can affect storage.

Keywords: insecticide, degradation, behaviour, heat, cold

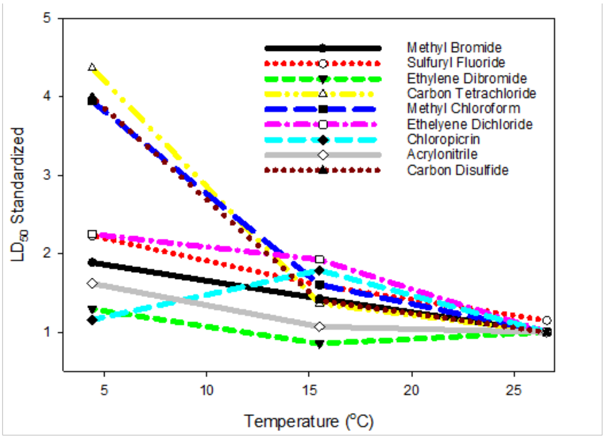

Fig. 1 Effect of temperature on efficacy of fumigants on *T. confusum*. LD_{50} are expressed as a proportion of LD_{50} at 26.7°C, data from Kenaga, 1961.

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Evaluation of insecticidal efficacy and persistence of Nigerian raw diatomaceous earth against *Callosobruchus maculatus* (F.) on stored cowpea

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Abstract

The insecticidal efficacy and persistence of Nigerian raw diatomaceous earth (DE) were evaluated in the laboratory on cowpea against *Callosobruchus maculatus* (F.) (Coleoptera: Chrysomelidae). The raw DE was applied to 1.5 kg lots of cowpea seeds at 0 (untreated control), 250, 500, 750, 1000 and 1500 mg/kg, and a commercial DE formulation (Protect-It®) applied at 1000 mg/kg was included in the test as positive (treated) control. The treated cowpea seeds were kept under ambient laboratory conditions (26 - 34°C and 24 - 93% RH. Bioassays were conducted on samples taken from each treatment at the day of storage and every 30 d for 6 consecutive months. Adult *C. maculatus* were exposed for 3 and 5 d to the samples and adult mortality was assessed over this exposure interval and progeny production and seed damage were assessed after additional 30 d. On freshly treated cowpea, both the raw DE and Protect-It® were highly effective against *C. maculatus* causing 100% adult mortality following 5 d of exposure. In general, the raw DE was less persistent on cowpea providing complete adult mortality only for two months. Protect-It® on the other hand was stable over the 6-month period of storage causing 95.8 to 100% adult mortality. None of the treatments completely inhibited progeny production after 2-3-moths storage period. The results of this study indicated that Protect-It® may provide suitable protection for 6 months against *C. maculatus*, but the raw DE in its present state is not suitable for long-term protection against this insect pest.

Keywords: *Callosobruchus maculatus*, raw diatomaceous earth, cowpea, residual activity

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is one of the most economically and nutritionally important indigenous African grain legumes produced throughout the tropical and subtropical areas of the world (Abate et al., 2011). It is a source of relatively low cost, high quality protein, and for many West and Central African farmers a major cash crop (Langyintuo et al., 2003). As production and consumption do not occur simultaneously, producers and traders need efficient storage systems to ensure year round cowpea availability for consumers. Consumers, on the other hand, want to buy cowpeas at the cheapest cost without compromising quality characteristics (Ndong et al., 2012).