

Title Direct and admixture toxicity of diatomaceous earth and monoterpenoids against the storage pests *Callosobruchus maculatus* (F.) and *Sitophilus oryzae* (L.)

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Abstract

We investigated the effects of two commercial diatomaceous earth based insecticides (DE), Protect-It[®] and SilicoSec[®], the nano-structured silica product AL06, developed by the section for Urban Plant Ecophysiology at Humboldt University Berlin, and the monoterpenoids, eugenol, and cinnamaldehyde on two stored product pests, *Callosobruchus maculatus* and *Sitophilus oryzae*. Protect-It[®] was more effective than SilicoSec[®] against *C. maculatus* while the reverse was true for *S. oryzae*. Generally *C. maculatus* was more sensitive towards DE and silica treatment than *S. oryzae*. Mortality rate of both pest species increased when DE's were applied to food commodities previously treated with a monoterpenoid. In admixture experiments, the toxicity of SilicoSec[®] + cinnamaldehyde (LD₅₀ = 42.73 ppm), SilicoSec[®] + eugenol (LD₅₀ = 24.30 ppm), and Protect-It[®] + eugenol (LD₅₀ = 2.60 ppm) was increased over DE alone against *S. oryzae*. Both substances showed a synergistic effect considering their co-toxicity coefficient relative to the LD₅₀-value. In contrast, we could not find any synergistic effects in experiments with *C. maculatus*. Here only Protect-It[®] + cinnamaldehyde (LD₅₀ = 20.84 ppm) showed an additive effect while all other combinations of monoterpenoid and DE indicated antagonistic effects. In addition to contact insecticidal effects both monoterpenoids showed a strong fumigant action. The presented results indicate that the natural product DE has great potential to replace synthetic pesticides commonly used in stored product pest management. Efficacy of DE can be improved by adding certain monoterpenoids against certain insect pests.

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