Silica nanoparticles: a potential carrier of chlorpyrifos in slurries to control two insect pests of stored products

Asghar Babamir Satehi¹, Masumeh Ziaee¹* and Ali Ashrafi²

¹ Department of Plant Protection, Faculty of Agriculture, Shahid Chamran University of Ahvaz, Ahvaz-Iran
² Department of Materials Engineering, Isfahan University of Technology, Isfahan-Iran
* Corresponding author: m.ziaee@scu.ac.ir

With 9 figures

Abstract: Application of organophosphorus insecticides is common as a residual surface treatment for controlling stored-product insects in silos and storages. To enhancement of insecticides effectiveness, loading them in silica nanoparticles as a carrier can maximize their toxicity with controlled release and is safer to the environment. In this study, silica nanoparticles were synthesized by sol-gel technique and loaded with chlorpyrifos as a carrier. Residual toxicity of chlorpyrifos loaded silica nanoparticles (Ch-SNPs) was evaluated as slurries on Petri dish, galvanized steel, mosaic and cement surfaces against adults of Rhyzopertha dominica F. and Tribolium confusum Jacquelin du Val. Adults were introduced to treated and untreated arenas at 7, 15, 30, 45 and 60-day post-treatment. Ch-SNP was found to be effective against both tested insect species. The mortality of both species exposed on Petri dishes treated with 0.01 g/m² Ch-SNPs was 100% even after 6 h exposure at 7-d post treatment time. However, on galvanized steel, the mortality of R. dominica and T. confusum ranged from 18.5 and 28.5% after 6 h exposure at 7-d post treatment which exceeded to 91.4 and 100% after 72 h, respectively. Residual toxicity of Ch-SNP on different surfaces was generally in the order of Petri dishes > galvanized steel > mosaic > cement. Results indicated that in more cases, T. confusum was more susceptible than R. dominica. Silica nanoparticles can be considered as a carrier to improve controlled release and stability of pesticides.

Keywords: Beetles, nanosilica, Rhyzopertha dominica, surface treatments, Tribolium confusum