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Dynamics and residues of chlorpyrifos and dichlorvos in cucumber grown in greenhouse

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ABSTRACT

The dynamics and residue contents of chlorpyrifos and dichlorvos in cucumber grown in greenhouse were investigated. The pesticides were applied at cucumber with different doses and spraying times. Analysis was carried out by liquid chromatography–tandem mass spectrometry. The degradations of chlorpyrifos and dichlorvos applied at 1.5 times recommended dose and 1 spraying times in cucumber coincided with $C_t = 0.0753e^{-0.433t}$, $C_t = 0.235e^{-0.199t}$, respectively. The half-lives obtained were 1.60 days for chlorpyrifos and 3.48 days for dichlorvos. When the cucumber treated with pesticides at the recommended doses and spraying times, the residues of chlorpyrifos was 0.036 mg kg^{-1} with 1 days interval which below the MRL established by EU, UK and Japan, dichlorvos was 0.008 mg kg^{-1} with 5 days interval which below the MRL established by EU and UK. When cucumber treated with pesticides at 1.5 times recommended dose or/and one more recommended spraying times, the residues of chlorpyrifos and dichlorvos were below MRLs with 5 or more days interval. Compared with 1.5 times recommended dose, the residue contents of chlorpyrifos and dichlorvos influenced more by one more recommended spraying times.

1. Introduction

The cucumber (*Cucumis sativus*) is a widely cultivated plant in the gourd family Cucurbitaceae and is grown on most continents (Encyclopedia Britannica Incorporated, 2008). According to the Food and Agriculture Organization of the United Nations, China produced at least 60% of the global output of cucumber, followed at a distance by Turkey, Russia, Iran and the United States (FAO, 2009). In China, greenhouse production of cucumber emerged as an important industry in the 90's and now is becoming more and more popular (Chang et al., 2011; Costa, Heuvelink, & Botden, 2004). Cucumber is susceptible to insect attacks. Whitefly, leaf miner, nematodes and other non-insect pests like two-spotted mites can gain entrance into the greenhouse through vents, doorways, openings in the greenhouse, and even on clothing and equipment. Intensive uses of pesticides are needed to control insects. The presence of pesticide residues may be accumulated at levels higher than international MRLs.

There were many examinations about behavior of pesticides in vegetables. Zhou, Lu, Liu, and Gan (2004, pp. 217–219) evaluated the fate of fipronil in vegetable-field ecosystem and provided the scientific basis of using this insecticide. Zhang, Liu, Yu, Zhang, and Hong (2006, 2007) investigated the dynamics of pesticides including chlorpyrifos, dimethoate, cyhalothrin, cypermethrin, fenvalerate, deltamethrin and chlorothalonil in the autumn Chinese cabbage and spring cabbage (*Brassica chinensis* L.). Omirou, Vryzas, Papadopoulou-Mourkidou, and Economou (2009) reported the dissipation rates of iprodione and thiacloprid applied in two different rates during tomato production in greenhouse. Reports by Maia, Silva, Rath, and Reyes (2009) evaluated the decline of the residues of oxytetracycline (OTC) in tomatoes grown in open field and greenhouse. Cengiz, Certel, and Göçmen (2006) determined the residue contents of dichlorvos and diazinon on cucumbers grown in greenhouses at 4 h and 4 days after the application of pesticides.

Chlorpyrifos (O,O-diethyl O-3,5,6-trichloropyridin-2-yl phosphorothioate) and dichlorvos (2,2-dichlorovinyl dimethyl phosphate) both are broad-spectrum organophosphate insecticide and widely used to control pests of various vegetables (Cox, 1995). Chlorpyrifos is moderately toxic and chronic exposure has been linked to neurological effects, developmental disorders, and autoimmune disorders (USDA, 1996a). Dichlorvos, like many OP insecticides, inhibits the enzyme cholinesterase, which results in disruption to the nervous and muscular system. It is highly toxic by inhalation, dermal absorption and ingestion (USDA, 1996b).

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