Agric Res J **61** (1): 6-12, *February* 2024
DOI: 10.5958/2395-146X.2024.00002.1

OPTIMIZING BIOLOGICAL EFFICACY: ACTIVE INGREDIENT SELECTION AND CONCENTRATION WITH FULL HOLLOW CONE NOZZLE FOR *TETRANYCHUS URTICAE* KOCH CONTROL

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ABSTRACT

The precise selection and concentration of active ingredients play a pivotal role in enhancing the mortality of *T. urticae*. In the present study, various parameters including droplet size, spray coverage percentage, deposition, penetrability, and distribution uniformity across the eggplant canopy were examined. Two pesticides, Dichlorvos 50% ES and Sulfur 80% WG, were used at different concentrations (50, 75, and 100 ml l^{-1} for Dichlorvos and 1, 3, and 5 g l^{-1} for Sulfur) in this study. The whole experiment was set up following complete randomized block design consisting of three blocks. Pesticides were applied at the test concentrations to evaluate their efficacy. The key findings involved significant variations in *T. urticae* mortality based on the active ingredients and their concentrations. Higher concentrations, especially of dichlorvos, exhibited a significantly high *T. urticae* mortality compared to sulfur. However, the deposition of active ingredients on the leaves did not influence the droplet characteristics on the target for both types. Utilizing dichlorvos at elevated concentrations during spraying has the potential to enhance control efficacy.

Keywords: Eggplant, greenhouse, nozzle, orientation, *T. urticae* control

Eggplant, *Solanum melongena* L., holds significant agricultural importance globally, valued for its fruit which is predominantly utilized as a vegetable (Rotino *et al.*, 2023). In Iraq, eggplant cultivation is substantial, with an estimated 54,469 don (1 don=2500 square meters) in cultivated area in 2020, particularly prominent in the Basrah province, contributing 3,992.9 tons to the total production in an area of 8,514 km² (CSO, 2020). Greenhouse cultivation enables year-round eggplant production, requiring bed preparation in October and subsequent insecticide applications depending on the prevalent pests (FAO, 2003). Insecticide use is crucial in eggplant cultivation (Prado-Lu, 2015), particularly to combat *Tetranychus urticae* Koch, a major pest in greenhouse eggplant cultivation (Jakubowska *et al.*, 2022). Despite pesticide application, some insects survive and reinfest fields post-treatment, reducing pesticide efficacy (Sanchez-Bayo, 2021).

Commonly, insecticides such as dichlorvos and occasionally sulfur are utilized for pest control in greenhouse crops. Dichlorvos is approved for use on vegetative crops without detrimental effects on plant growth (Wang *et al.*, 2022). The correlation between active ingredients and their concentrations is crucial for effective pest control while minimizing environmental harm (EPA, 2024).

Optimal *T. urticae* control is achieved by directly spraying eggplants at a specific height above the plant's upper surface (Alper *et al.*, 2019). Canopy coverage poses a significant challenge to *T. urticae* control (Whitehead, 2017), as insufficient droplet penetration may leave some vegetation inadequately covered. Insufficient coverage limits *T. urticae* movement under leaf surfaces (Yeary *et al.*, 2018; Lewis and Hamby, 2020).

Achieving sufficient spray droplet coverage percentage is paramount for effective pest control (He *et al.*, 2022), influenced by the plant canopy structure, plant species, and growth stage (Musiu *et al.*, 2019). In eggplants, insecticide coverage varies significantly during plant development, with reduced deposition at lower canopy layers compared to upper layers (Hua *et al.*, 2020; Abraheem and Alheidary, 2022; Ibraheem and Alheidary, 2023). Reduced canopy protection may diminish insecticide exposure, uptake, and efficacy (Prado-Lu, 2015). Strategies to enhance spray penetration through plant canopies include increasing application volume and altering nozzle orientation (Derksen *et al.*, 2008; Foque *et al.*, 2012; Ibraheem and Alheidary, 2023). While nozzle type had minimal impact in a direct application study, increasing application volume potentially improved control efficacy. Nozzle effectiveness is also influenced by spray solution formulation, affecting canopy penetration (Alheidary *et al.*, 2014; Sijs and Bonn, 2020).

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Date of receipt: 04.09.2023, Date of acceptance: 18.02.2024