Ceylon Journal of Science

Research Articles

Optimizing spray volumes of different spraying devices under controlled conditions for Abelmoschus esculentus (Okra) cultivation: A scientific exploration towards automation in spraying

N. Mayuresh, S. Loveciya, N. Kannan

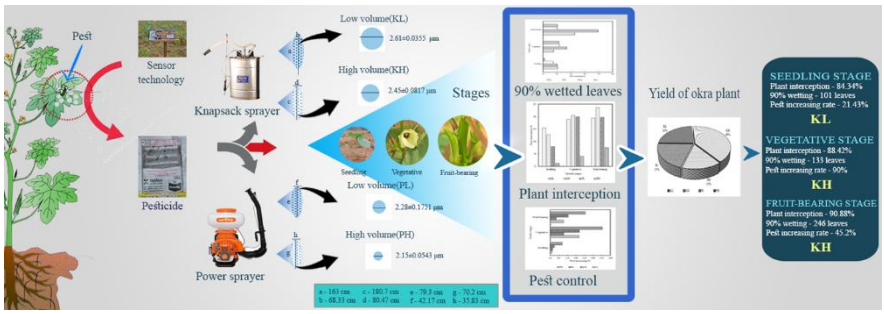
Department of Agricultural Engineering, Faculty of Agriculture, University of Jaffna, Ariviyal Nagar, Kilinochchi 44000, Sri Lanka

Received: 28.11.2024 *Accepted: 17.02.2026*

Highlights

- Hand-operated high-volume sprayers achieved superior plant coverage and pest control
- Effective pest management depended on wetting efficiency; hand-operated sprayers excelled
- Okra pods under hand-operated high-volume treatment were longest, indicating better plant health
- Power-operated sprayers yielded less due to reduced efficacy in pest control

Graphical abstract



Abstract

Spraying is one of the important techniques to control pest infestation in vegetable fields. Improper pesticide application leads to chemical wastage and ineffective pest control, causing environmental pollution and ultimately reducing crop yield. To overcome these issues and to suggest suitable spraying techniques for particular growth stages of *Abelmoschus esculentus* (okra), a comprehensive field experiment was planned. Four different spraying techniques using hand-operated knapsack sprayers and power-operated knapsack sprayers: hand-operated knapsack low-volume (KL), hand-operated knapsack high-volume (KH), power-operated knapsack low-volume (PL), and power-operated knapsack high-volume (PH), were used with the incorporation of sensor technology to identify the pest and suitable pesticides . Major differences in droplet sizes among the treatments KL, KH, PL, and PH were 2.6±0.03 µm, 2.4±0.08 µm, 2.3±0.17 µm, and 2.1±0.05 µm, respectively. The results showed that treatment KL outperformed the other treatments at the seedling stage, and treatment KH was the optimal choice for the vegetative and fruit-bearing stages of okra for plant infestation and 90% wetting. The highest pest infestation was observed during the vegetative stage. Yield performance was induced by treatment KH, with the longest average pod length at 23.2±0.37 cm. Overall, with the advantages of plant interception, environmental loss, plant height, and pest infestation level, the KH more effectively supported all stages of okra development. The findings of this study emphasized a suitable spraying technique for each growth stage of okra with minimum environmental loss by incorporating sensors. The use of technology in basic agricultural activities is highly expected; thus, these findings will be useful for agricultural experts, farmers, and researchers in promoting eco-friendly and sustainable agriculture by minimizing chemical usage through precision pest management.

Keywords: Automation, Okra, Optimization, Spray volume, Sprayer