XVII[th] World Congress of the International Commission of Agricultural and Biosystems Engineering (CIGR)

Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB)
Québec City, Canada June 13-17, 2010

DESIGN OF AN AUTONOMOUS SPRAYING ROBOT FOR GREENHOUSE

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CSBE101012 – Presented at Section V: Management, Ergonomics and Systems Engineering Conference

ABSTRACT Chemical applications are intensively applied in agriculture to overcome insects and plant diseases which cause significant damage to pepper production. However, the extensive current use of pesticides in agriculture has several disadvantages: a) high cost, b) an increase in pest immunity, c) high poisoning in pesticide leaves a leftover toxicity in produce, as well as poisoning the food chain and environment. Another drawback is the manpower required for the application. The increase in human labour costs combined with the shortage of available workers and the will to develop safer and cheaper ways to apply the pesticides has lead to the development of autonomous spraying systems. The objective of this research is to design an autonomous robot for spraying in pepper greenhouses from a systems engineering aspect. A model which simulates the workspace and the requirements of the robot was developed. The performance of the autonomous sprayer is determined by a comparison to a conventional sprayer. The parameters analyzed include the nozzles position, the number of nozzles, limits of pesticide dose requirements for the spraying systems and influence of the environment. Two simulation models have been developed. One examines the system efficiency according to the amount of material needed in order to cover an infected area and the distribution pattern of the material on the plant. The other model examines the efficiency of the dynamic design of the autonomous robot. Both models incorporate an economic analysis model. The parameters examined include greenhouse size; efficiency and accuracy of spraying; the size of the pesticide tank; pace of spraying progress; and width of the areas sprayed by nozzle sprayers. Deviations in horizontal angles of sprayer boom and distance from the row center have been considered in the analyses. The result shows that adjusting the tank size to suit the length of the row can improve the sprayer performance. Using the adequate distance between the nozzles can save costs of pesticide and also improve the sprayer performance.

Keywords: robot, spraying, greenhouse, pepper.