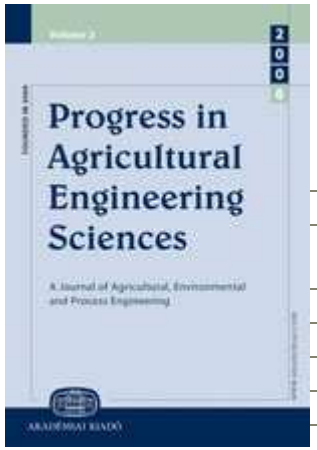
## Article de revue




# Development of process control system for potential use of direct injection spraying technology

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**Résumé**

Small-scale farmers face to actual difficulties of applying pesticides accurately and safely on vegetables crops. They mainly use hand operated sprayers. As an issue, a small direct injection system based on a five meter's parallel boom layout was designed to improve chemical application. The boom layout was optimized to obtain the same minimal time lag response for the ten nozzles. The dynamic of the system was modeled using Simulink TM as first order model with delay. Two control strategies were implemented using PID (Proportional Integral Derivative) feedback control loops to monitor tracer injection (fluorescing) proportionally to simulated forward speed (from 0.6 to 1.2 m/s) and to control the constant operating pressure (constant carrier flow strategy) or the variable operating pressure proportionally to the injected chemical amount (variable total flow strategy). Different forward speed changes were induced using steps up and down, ramps, sine waves and sweeps excitations to evaluate the control feedback. The system stability was tested for its ability to maintain the expected concentration and application rate. The results show that the time lag remains less than 3 s (dead time < 2 s, time constant < 1 s) and the system keeps stable for the maximal speed variation (ΔV) and acceleration (ā) tested (ΔV = 200%, ā = 0.48 m/s$^2$) which induce less than 10% variation of application rate.

**Mots-clé**

feedback control, direct injection, variable rate application, simulation

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# Development of Process Control System for Potential Use of Direct Injection Spraying Technology

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Small-scale farmers face to actual difficulties of applying pesticides accurately and safely on vegetables crops. They mainly use hand operated sprayers. As an issue, a small direct injection system based on a five meter's parallel boom layout was designed to improve chemical application. The boom layout was optimized to obtain the same minimal time lag response for the ten nozzles. The dynamic of the system was modeled using Simulink TM as first order model with delay. Two control strategies were implemented using PID (Proportional Integral Derivative) feedback control loops to monitor tracer injection (fluorescing) proportionally to simulated forward speed (from 0.6 to 1.2 m/s) and to control the constant operating pressure (constant carrier flow strategy) or the variable operating pressure proportionally to the injected chemical amount (variable total flow strategy). Different forward speed changes were induced using steps up and down, ramps, sine waves and sweeps excitations to evaluate the control feedback. The system stability was tested for its ability to maintain the expected concentration and application rate. The results show that the time lag remains less than 3 s (dead time < 2 s, time constant < 1 s) and the system keeps stable for the maximal speed variation ($\Delta V$) and acceleration ($\delta$) tested ($\Delta V$ = 200%, $\delta$ = 0.48 m/s²) which induce less than 10% variation of application rate.

**Keywords:** feedback control, direct injection, variable rate application, simulation

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