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### TEST AND EVALUATION OF TWO PROCESS CONTROL STRATEGIES FOR ADAPTING DIRECT INJECTION PESTICIDE APPLICATION TO SMALL SCALE FARMS

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**ABSTRACT** Small scales farmers, in developing and in some developed countries, are faced with actual difficulties regarding the application of pesticides accurately and safely on vegetable crops, mainly due to the use of the hand operated sprayers. To help resolve this issue, a small direct injection system based on a parallel boom layout was designed to improve chemical application. The boom layout was optimised to obtain the same minimal lag time response for the ten nozzles. Two control strategies were implemented using PI feedback control loops for monitoring tracer injection (fluorescing) proportionally to simulated forward speed (from 0.6 to 1.2 m/s) and for controlling pressure to maintain carrier flow constant (constant carrier flow strategy) or for controlling a variable operating pressure proportionally to the injected chemical amount (variable total flow strategy). The dynamics of the system was approached as first order model with delay and optimised on the basis of reaction curve method. Three forward speed magnitudes (0.6 to 0.9, 0.9 to 1.2 and 0.6 to 1.2 m/s) were induced using different solicitations (up and down steps, ramps, sweeps and sine waves) and by simulating different accelerations (1.2, 3 and 4.8 m/s<sup>2</sup>) and frequencies (0.2, 0.3 and 0.4 Hz). The system stability was tested for its ability to maintain the expected application rate. The results show that the lag time remains less than 3 s (dead time < 2s , rise time < 1s) and the system remains stable for the maximal speed variation and acceleration tested (?V=200%, a= 0.48 m/s<sup>2</sup>) which induce less than 10% variation of application rate.

**Keywords:** Feedback control, direct injection, variable rate application, small scale farms