TIP FLOW UNIFORMITY WHEN USING DIFFERENT AUTOMATIC SECTION CONTROL TECHNOLOGIES DURING FIELD OPERATIONS

A. Sharda, J.P. Fulton T.P. McDonald and D. Mullenix

Biosystems Engineering Department
Auburn University
Auburn, Alabama

J.D. Luck and S.A. Shearer

Biosystems and Agricultural Engineering Department
University of Kentucky
Lexington, Kentucky

ABSTRACT

Automatic section control (ASC) technology provides a means to reduce overlap and application in unwanted areas. However, the impact of ASC on spray boom dynamics and tip flow uniformity are unknown. Therefore, a study was conducted to evaluate tip flow rate uniformity and control system response in maintaining target application rates during field operation. Field experiments were conducted using two self-propelled sprayers equipped with commercially available spray controllers with ASC capabilities. High frequency pressure transducers were mounted across the spray boom to record tip and system pressure during field application. Results indicated tip-to-tip uniformity or CVs in the range of 10% to 40% consistently occurred during ASC engagement or ground speed changes. The variation between actual and target tip flow rates (off-rate) was frequently outside ±10% of target application rate. Off-rate and uniformity maps suggested that these application variations were primarily due to required system flow rate changes by the control system to maintain the set target rate as spray width and/or machine acceleration occurred. Further, differences existed between auto-boom and auto-nozzle level control during these field tests with each generating their unique application errors.

Keywords: Liquid application, pressure, distribution, as-applied maps

INTRODUCTION

Automatic section control (ASC) technology has become widely adopted by precision ag practitioners to reduce double-coverage and application in unwanted areas thereby leading to input savings and improved environmental stewardship.

However, the impact of ASC on spray boom dynamics and tip flow uniformity are unknown. Therefore, a field study was conducted to evaluate tip distribution uniformity and control system response in maintaining the target application rate.

METHODOLOGY

Experiments were conducted using two self-propelled sprayers equipped with commercially available spray controllers with ASC capabilities. High frequency pressure transducers were mounted across the spray boom to record tip pressure during field application. These data along with GPS location, time, and ground speed were also recorded simultaneously and written to a text file. Tip pressure was converted to flow rate, using manufacturers tip specification data, to calculate CV across the boom and actual application rate to determine off-rate application.

RESULTS

Results indicated tip-to-tip uniformity or CVs above 10% occurred frequently for these sprayers (Fig. 1). Similarly, off-rate application beyond ±10% occurred a high percentage (>50%) during field applications. Theses high CVs and off-rate application errors were contributed to frequent ASC engagement and ground speed variations thereby impacting spray boom dynamics effecting application efficacy across fields.

Fig. 1. Tip flow rate uniformity (%) for spray application with travel direction for Field A.

CONCLUSIONS

Variations in tip distribution uniformity and actual application rates indicated difference between system flow meter and actual tip response. These variations were primarily due to the required system flow rate changes by the control system to maintain the set target rate as spray width and/or machine acceleration occurred. Further, differences existed between auto-boom and auto-nozzle level control during these field tests with each generating unique application errors.