



The Aim Game: Precision Spray Technology

Robin Rosetta
Oregon State University

Intelligent Spray Systems Research

- An overview of prior intelligent spray system research
- Current research
- Future plans

Using sensors so we don't spray the empty spaces, we reduce the volume of agricultural pesticides applied by 47-70% with equivalent control.



Development and Evaluation of a Laser-Guided Air-Assisted Sprayer in Nursery Production

Robin Rosetta¹, Heping Zhu², Michael E. Reding², Randall H. Zondag³, Chris Ranger², Luis A. Cañas⁴, Amy Fulcher⁵, Charles Krause², Yue Shen², Hui Liu², Yu Chen², Erdal Ozkan⁶, Richard C. Derksen², James Locke², and Stanley Ernst⁷

¹Oregon State Univ., Aurora, OR, ²Application Technology Research Unit, Wooster, OH, ³Ohio State Univ., Painesville, OH, ⁴Department of Entomology, Ohio State University, Wooster, OH, ⁵Plant Sciences Department, University of Tennessee, Knoxville, TN, ⁶Department of Food, Agriculture, and Bioengineering, The Ohio State University, Columbus, OH, ⁷Agric Environmental and Devlp Econ, The Ohio State University, Columbus, OH

Variable-rate hydraulic boom spray system development


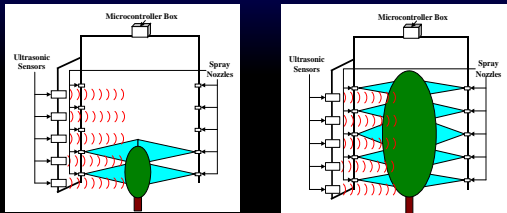


Photo: Sam Doane

Variable-rate hydraulic boom spray system development



Laser-guided air-assisted sprayer

Laser sensor
PWM flow control valves
Five-port nozzles
Algorithms
Speed sensor
Controller circuits
Embedded computer & touch screen

Algorithm to use tree structure for controlling each nozzle spray output

270° radial, 30-m range
Section volume
Convert point-to-point distances to surface structures
Spray output from i^{th} nozzle

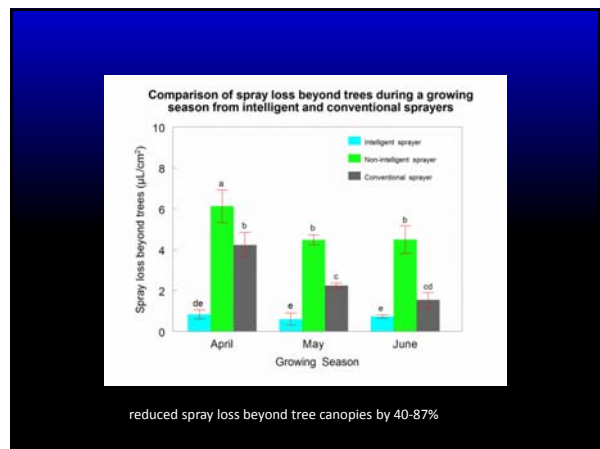
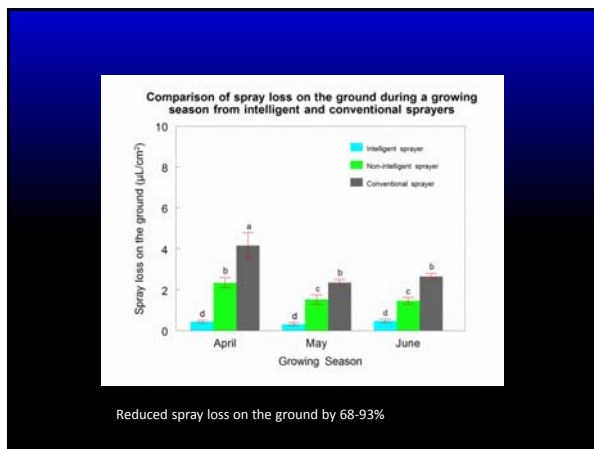
$$Q_i = \frac{E_{vol}}{t} = \frac{h \cdot W \cdot v \cdot t \cdot \rho \cdot \nabla}{t} = h \cdot W \cdot v \cdot \rho \cdot \nabla$$

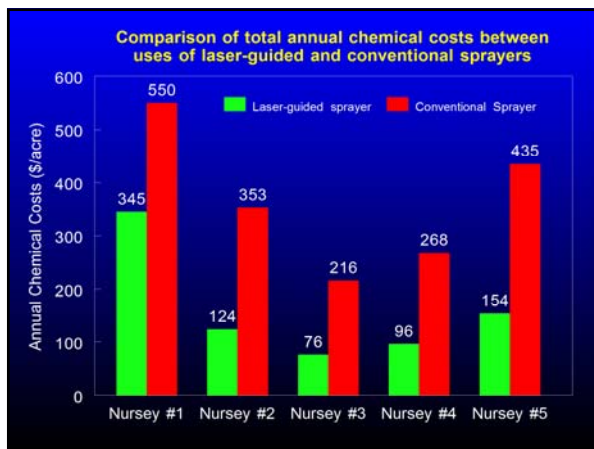
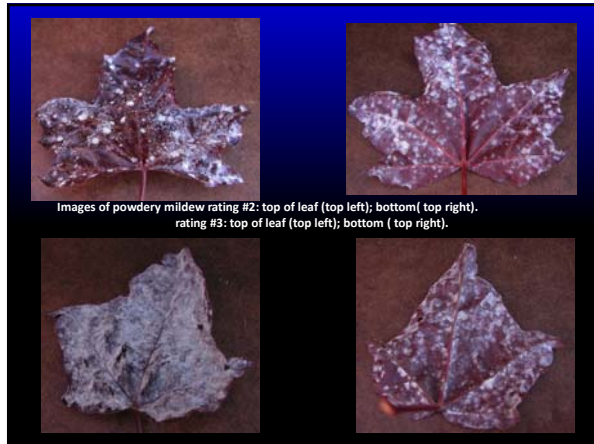
PWM valve duty cycle

$$DUC_i = \frac{h \cdot W \cdot v \cdot \rho \cdot \nabla + 73.88}{6.56}$$

In OARDC test plot

The new sprayer discharges sprays from each nozzle independently based on tree structures and foliage volume





Conclusions

Compared to conventional sprayers, intelligent sprayers greatly:

1. increased spray deposition uniformity consistency inside canopies at different growth stages,
2. minimized off-target losses (40-87% reduction in spray loss around tree canopy, up to 87% reduction in airborne spray drift, 68-93% reduction in spray loss on the ground),
3. reduced pesticide use by 47-70%,
4. annual chemical savings by \$140-\$281 per acre.

Comparable controls of insects and diseases.






Advancement of Intelligent Spray System Technology

Heping Zhu¹, Jennifer Boldt¹, Monica Cooper², Amy Fulcher², Yu Gao³, Dan A. Herms³, Charles Krause¹, Peter Ling³, David Lockwood³, Lloyd Nackley⁵, Genhua Niu⁴, Erdal Ozkan³, Jay Pscheidt⁶, Robin Rosetta⁶, Guido Schnabel⁶, Ajay Shah⁷, Lingying Zhao³, Randall H. Zondag³

¹USDA-ARS Application Technology Research Unit, ²University of Tennessee, ³The Ohio State University, ⁴Texas A&M University, ⁵Oregon State University, ⁶Clemson University, ⁷University of California Cooperative Extension





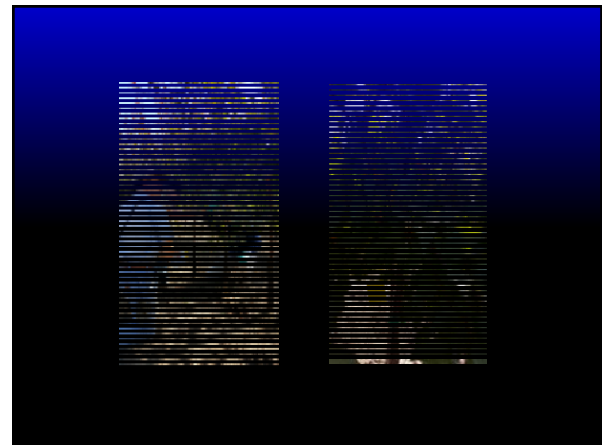
Seven different retrofit designs implemented



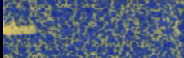
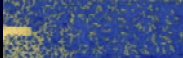
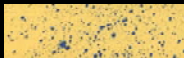


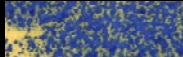


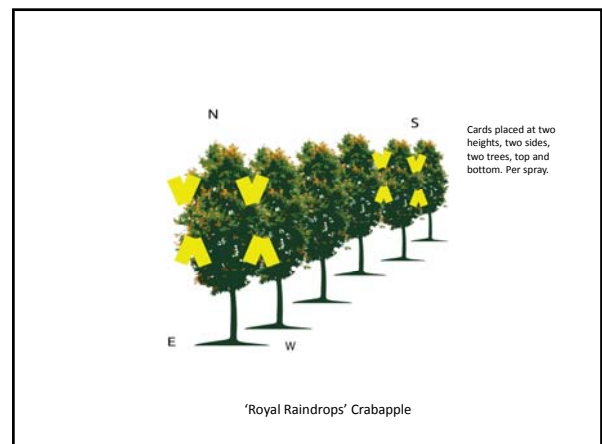


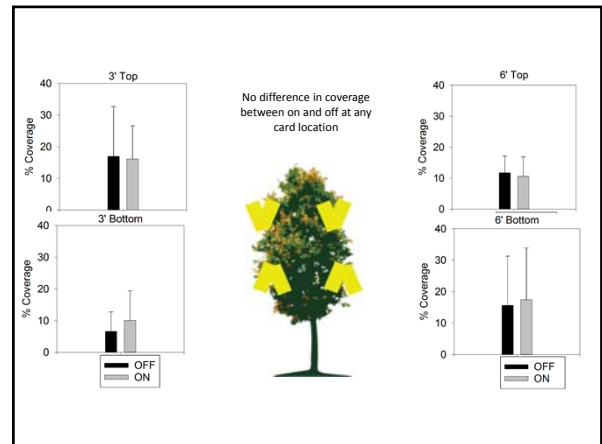
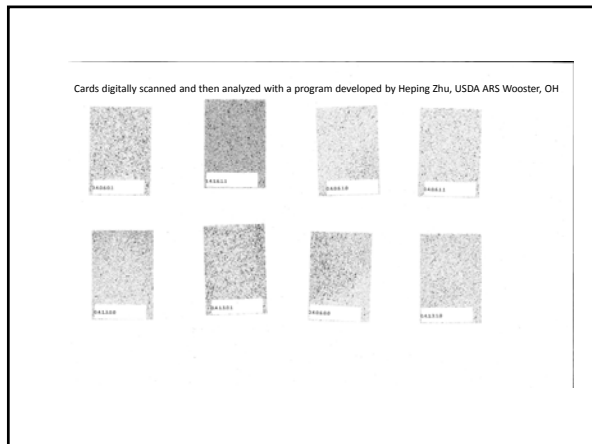




Spray coverage on water sensitive papers

	Laser-guided variable-rate spray	Constant-rate spray
In front of canopy		
Behind canopy		
At gap between two canopies		





Acknowledgements

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