

## **The development of a spray monitoring system for fruit crops as an aid to farm management and traceability**

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### **Introduction**

How does a farmer or manager know how much spray has been applied in the orchard or vineyard? Current methods rely upon the integrity of the operator and machine. How does the operator know which row has been sprayed and which hasn't? In many European countries recording pesticide use is a mandatory requirement and many farmers find it a tiresome task manually entering pesticide application data into record books. Traceability in food supplies has become extremely important. Consumers need to be reassured by the grower and the supplier that their food is safe and that pesticide residues are within the acceptable legal limits. Products that are eaten directly without processing, such as apples and table grapes, provide a particular challenge.

Larzelere and Landers (2010) documented the development of a Real Time Kinematics GPS (rtkGPS) sprayer monitoring system. This proved very accurate but was very expensive for many growers and prohibitively expensive for smaller orchards and vineyards.

This paper documents the development of a low-cost, effective recording and documentation system that can be retrofitted to almost any sprayer. The system allows the farm manager to easily download the spraying data at the end of a workday for analysis and use in the compilation of the spraying reports.

### **Materials and Methods**

A detection system was developed using a Radio Frequency Identity (RFID) card reader with 4 antennas (ALR-9680, Alien Technology, Ltd., California, USA). On each side, 2 antennas were fixed at different heights and different directions (Figures 1 and 2) to increase the detection scope and make card capture more likely. The position and direction of the RFID cards on the end posts of the rows was also evaluated by comparing signal strength in relation to direction. Flow rate to each side of the sprayer was detected using Raven RF15 flowmeters (Raven Industries, South Dakota, USA), one fitted to each side.

The complete detection system was tested in a *vitis vinifera*, var. Chardonnay, vineyard with 2.45m rows. The tractor and sprayer were driven past the RFID cards, attached to the end posts of the rows, at 0.63, 1.12 and 1.79 m·s<sup>-1</sup>, 10 replications were made.

Information from the RFID cards (location, row number, left/right hand side) was combined with information from the flow meters. The speed of the sprayer was monitored using a simple GPS device (GPS Magellan eXplorist 210, California, USA). A computer program was written to analyse this information and a tablet computer on the tractor displayed location, application rate, row number and forward speed, Zhai et al (2014).



Figure 1. Test tractor

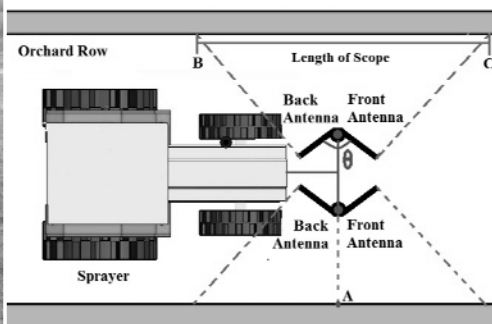


Figure 2. Schematic diagram

**Results**

Table 1 shows the results of one of many trials conducted in the development of the monitoring device.

Table 1. Test results of the RFID card reading in the vineyard

Speed /MPH	Speed/ m·s <sup>-1</sup>	Antenna position	Reading Number of RFID Card										Average Number Detected
			1	2	3	4	5	6	7	8	9	10	
1.4	0.63	Front	2	2	2	2	5	3	3	2	3	4	2.8
		Back	3	4	3	4	5	4	3	3	3	3	3.5
		Total	5	6	5	6	10	7	6	5	6	7	6.3
2.5	1.12	Front	1	2	2	2	1	2	1	2	2	2	1.7
		Back	2	2	2	3	3	3	2	2	1	2	2.2
		Total	3	4	4	5	4	5	3	4	3	4	3.9
4.0	1.79	Front	1	1	1	0	1	1	1	1	1	1	0.9
		Back	2	1	1	2	2	2	1	1	1	2	1.5
		Total	3	2	2	2	3	3	2	2	2	3	2.4

**Conclusion**

A low-cost sprayer flow monitoring system developed in this research provided consistent data and provides the modern orchard or vineyard manager documentation suitable for farm management and traceability purposes.

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**References**

Larzelere, W. and Landers, A.J. (2010). Development of a spray monitoring system for a vineyard canopy sprayer. Paper No. 1009012, ASABE, 2950 Niles Road, St Joseph, MI 49085-9659

Zhai, C., Landers, A.J. and Zhang Bo (2014) Performance of Orchard and Vineyard Spray Monitoring System using RFID Technology. Paper 2014-0049 Proc. 18th World Congress CIGR Agricultural Engineering, 18th September, Beijing, China