



Cost effective robots for smart precision spraying

Orchard spraying based on sensors and PWM

Lidar Scanners:

Function: Measure the canopy density of orchard trees.

Benefits: Adjust spray volume based on tree volume and stop spraying where foliage is absent (e.g., missing trees or pruned branches).

Key Technologies



Fluorescence-Based Sensors:

Function: Measure crop health status by detecting crop stress.

Benefits: Adjust spray deposition according to crop stress levels for targeted treatment.

Accurate knowledge of the distance between the sensor and spray nozzle, driving speed, and sprayer reaction time **is crucial** for precise droplet placement on branches and leaves.

Real-time spray volume adjustments using sensor-based technology and PWM nozzles offer significant advantages in precision, efficiency, and crop health management. By integrating farmer knowledge with advanced technology, these systems can lead to substantial savings and better environmental outcomes

Apple Orchard Project Case

- **Technology Used:** Lidar scanners combined with PWM nozzles.
- **Achieved a 250% increase in spray deposition, indicating significant savings in plant protection products while ensuring effective coverage.**

Spray Nozzle Adjustments

Pulse Width Modulated (PWM) Nozzles:

- **Functionality:** At 100% duty cycle, acts like a traditional nozzle. At lower frequencies, closes part of the time, reducing volume rate while maintaining pressure and droplet size.
- **Advantages:** Electronically activated, capable of adjusting volume rates up to 100 times per second, matching sensor-driven requirements and dose algorithms

Traditional Methods:

- **Spray Pressure Adjustment:** Impacts droplet size and is a slower process.
- **Nozzle Control:** Turning specific nozzles on and off.

Development of Dose Rate Algorithms

- **Relates sensor signals to the applied spray volume rate.**



- **Requires integration of farmer and crop advisor knowledge with the technical system capabilities**

Considerations:

- **Agronomical Limits:** Sensor values have minimum and maximum thresholds.
- **Volume Rate Limits:** Changes in volume rates must stay within agronomical boundaries.
- **BBCH Growth Stages:** Algorithms relate biomass measurements to appropriate volume rates for defined growth stages