Evaluating the Efficacy of Intelligent Sprayer Technology in Conjunction with Warning Systems for Apple Diseases

Olivia Meyer—graduate student, Department of Horticulture

Mark Gleason—professor, Plant Pathology and Microbiology

Apples are the most economically valuable fruit crop in the United States. However, managing the multitude of pests and diseases that target apples is costly and can pose health hazards.

Sooty blotch and flyspeck (SBFS) and fire blight are common pathogens in apples that are highly prevalent in regions that experience warm temperatures and extended periods of wetness.

To control pests and diseases, air-assisted (airblast) sprayers and calendar-based spray systems for pesticides have been the industry standards. However, airblast sprayers don't target sprays very accurately, so they waste a large percentage as off-target drift, and calendar-based spray systems don't account for environmental conditions to predict disease outbreaks more accurately.

A modified airblast sprayer called an Intelligent Sprayer, which is now commercially available, uses Light Detection and Ranging (LiDAR) technology to target pesticide sprays more precisely, and weather-based warning systems have been developed and modified to predict the risk of SBFS and fireblight outbreaks.

Using a weather-based warning system combined with Intelligent Sprayer technology could save pesticides in two ways: reducing the amount of pesticide applied in each spray and limiting the number of applications.

Our 3-year (2020-2022) project in Iowa and Ohio is testing how well the Intelligent Sprayer can combine with disease-warning systems to reduce the pesticide load on orchards.

Materials and Methods

A 'Gibson' Golden Delicious block planted in 2003 was divided into four subplots per treatment in a randomized complete block experimental design. Treatments included:

Treatment	Sprayer Type	Sprayer Timing	Sprayer Volume
1	Intelligent	Calendar	Low
2	Intelligent	Calendar	High
3	Intelligent	Warning	Low
4	Intelligent	Warning	High
5	Standard	Calendar	100GPA
6	Standard	Warning	100 GPA

In the 2021 experiments, the high flow rate of the Intelligent Sprayer was 0.09 fl oz/ft.^{3}, and the low flow rate was 0.06 fl oz/ft.^{3}. For the SBFS warning system, relative humidity (RH) hours were recorded using a WatchDog weather station for the warning system treatments after first cover. Once 385 RH hours at or above 90% humidity were reached, the warning system fungicide sprays were resumed on a calendar-timed basis.

For the fire blight warning system (Maryblyt), wetness data (rain or dew) and minimum and maximum temperature values were recorded using leaf wetness sensors and a WatchDog weather station, respectively, from bloom to petal fall. The Maryblyt warning system uses weather inputs to determine when an antibacterial spray is needed.

Yield data were taken at the end of the growing season from three randomly selected trees per subplot. The number and weight of marketable and non-marketable fruit were recorded. Incidence of disease and pest-insect damage was recorded by examining 25 arbitrarily selected fruit from both the upper and lower halves of each tree. Spray coverage data were collected on three dates that represented different levels of canopy density, using water-sensitive paper cards placed at eight locations per tree. A subset of marketable apples is being stored for three months, with monthly assessment for fruit rot incidence.

Results and Discussion

The standard airblast sprayer used the most spray volume per tree; volume for the Intelligent Sprayer was 44 to 55% lower, depending on the nozzle setting (Figure 1). The SBFS warning system saved four fungicide sprays, and the Maryblyt warning system saved one bactericide spray vs. calendar-based spray timing during a relatively dry growing season. SBFS signs did not appear in any treatment, and pest-insect damage did not differ among the treatments. The warning system thus reduced the number of fungicide sprays, and the Intelligent Sprayer reduced volume for all pesticide sprays.

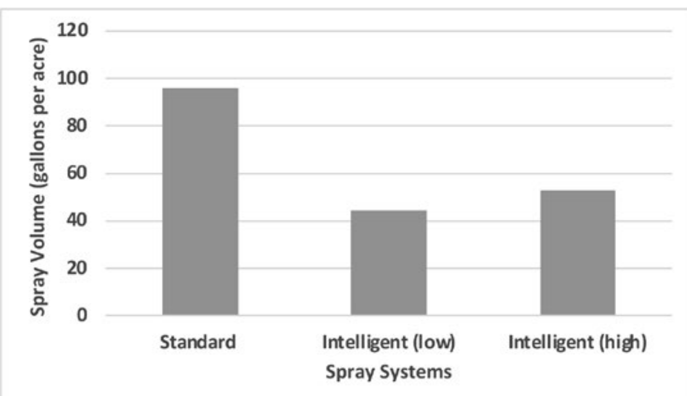

Figure 1. Spray volume average per treatment during the 2021 growing season.

Acknowledgments

We thank the USDA-NIFA CPPM Program for funding this project and the Iowa State University Horticulture Research Station staff and Gleason Lab personnel for invaluable technical and labor assistance.