Improving Crop Protection and Production Strategies for Horticultural Crops

PRINCIPAL INVESTIGATOR:
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PROJECT OBJECTIVES:
Develop new or enhanced delivery technologies that provide the most efficacious application of production materials, including nutrients and pest management materials.

ACCOMPLISHMENTS:
Several different application trials have been conducted to determine how to improve pesticide delivery to mature poinsettia canopies in ATRU and OSU greenhouse test facilities. Handgun trials revealed that canopy position was a significant factor in the amount of spray found on foliar and artificial targets. Limiting spray delivery to only one direction resulted in as much as 10 times higher spray deposits in the fronts and upper areas of the canopy than the backs and lower areas of the canopy. Droplet size produced by the various handgun treatments did not significantly affect spray deposits. Higher spray volumes, achieved by slower application speeds, tended to produce higher spray deposits. The results of this study of handgun application experiment demonstrate the importance of knowing the limitations of the equipment in each cropping system to help ensure an efficacious application. Also, the ability to target the spray more precisely is likely more important for achieving the highest spray deposits than the droplet size or spray volumes used for handgun delivery.

As a follow-up to the trial that demonstrated the need for more precise targeting of spray, a bench-top trial was conducted examining the differences in abaxial surface spray deposits by handgun and broadcast spray treatments. Trials revealed significant differences between the amount of spray found on upper and lower elevation canopy target areas. Handgun nozzle pressure was a more significant factor in depositing material on the abaxial surface of leaves than changing application rate. A boom system using dual-orifice twin-fan nozzles did not treat abaxial leaf surfaces differently from the handgun applications. The flat-fan treatment with air-assisted delivery produced the highest mean deposits on the abaxial surface of leaves in the lower canopy area but overall there were no statistical differences in lower canopy deposits between treatments. The large amount of variability observed in these trials between test plants demonstrates the difficulty ornamental producers have targeting pesticide placement in the canopy such as the abaxial leaf surfaces lower in the canopy. Variability in deposits could significantly impact efficacy and pest management strategies as well as pesticide choice.

Building on the observations of the air-assist sprayer in the bench-top trials, further experiments were conducted to evaluate the effectiveness of different air outlet speeds, travel speed, and sprayer output on abaxial surface deposits in a mature poinsettia canopy. The combination of high nozzle output and slow Travel Speed tended to produce the highest abaxial surface deposits. Higher deposits at the slower Travel Speed were likely due to the increased air velocity and turbulence in the canopy. There were indications that spray deposits on the abaxial surface of leaves increased with increasing Air Outlet Speed which also likely increased turbulence in the canopy. However,

Air Outlet Speed appeared to be a more significant factor in the upper elevation than the lower elevation. The dense nature of the mature poinsettia canopy and relatively large leaves likely dissipated the energy of the air and significantly reduced the amount of turbulence deeper in the canopy. Across all Air Outlet Speeds, for the range of application rates evaluated, spray deposits tended to increase with increasing application rate. These greenhouse trials provide floral producers with evidence of the importance of understanding how to best use their pesticide application equipment to make the most efficient use of time and materials to achieve the desired results. However, even when used in the most efficient manner, it is still difficult to achieve uniform delivery of products in the most efficacious manner.

Because of the concern regarding off-target spray movement in nurseries and other tree production sites, spray drift trials are being conducted using conventional and tower sprayers to treat 12-foot tall fruit trees. Trials focused on off-target spray measured downwind using ground and airborne samplers. Even with the conventional air blast sprayer set-up to direct spray at only the mature canopy of the 12-foot tall trees, a significant amount of airborne spray material was found over 20 feet higher than the canopy less than 30 feet downwind from the treatment area. The tower sprayer significantly reduced the amount of off-target airborne spray particles above the canopy compared to the conventional air blast sprayer. The conventional air blast and tower sprayers produced similar ground deposits at a point 330 feet downwind from the outside of the treatment area. The drift trials also revealed that while a mature tree canopy can filter out spray material, it is more likely to send spray particles up into the atmosphere than a dormant, leaf-less canopy. As a result of this research, tree producers have a better understanding of their impact on the environment and how they can apply materials to minimize off-target spray movement.

TECHNOLOGY TRANSFER/IMPACT:
This research has been published in scientific journals including Transactions of the ASABE and Journal of Environmental Horticulture. Invited presentations of research have been made at the annual meeting of the Ohio Florists Association and nursery and greenhouse workshops across Ohio and Oregon. Partnerships have been made with researchers, manufacturers, and extension educators across the country to develop technology that will have the greatest impact with stakeholders.

ADDITIONAL FUNDING/EXTERNAL SUPPORT:
At this time, no additional outside funds have been used for this research besides those contributed by collaborators to help conduct the research. Funding is expected for a planning grant to help evaluate producers' tree sprayer technology needs and limitations to adoption of new pesticide application technologies.

COLLABORATORS:
ARS: Heping Zhu (formulation characteristics, droplet sizing), Michael Reding (nursery ornamental insect management support), Chris Ranger (greenhouse/nursery pest management support), James Locke (ornamental disease management support), and Jonathan Frantz (ornamental plant production, greenhouse test facility), ARS Wooster/Toledo, Ohio.
University: Peter Ling (greenhouse test facility, sensor research support) and Luis Canas (greenhouse plant production and insect efficacy evaluations) Ohio State University; Ohio Agricultural Research and Development Center.