A SPECIALLY DESIGNED AIR-ASSISTED SPRAYER TO IMPROVE SPRAY PENETRATION AND AIR JET VELOCITY DISTRIBUTION INSIDE DENSE NURSERY CROPS

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ABSTRACT *New sprayers are needed to deliver droplets uniformly within dense nursery crops to obtain healthy and marketable plants in the nursery industry. An air-assisted sprayer with five-port nozzles was developed and investigated to improve spray penetration into dense nursery canopies. Spray deposits at the top, middle, and bottom of canopies were characterized* [(Sing *fluorescence detection, and were compared at three nozzle heights in a commercial nursery field. Dynamic air velocities corresponding to the deposit sampling !creations inside and outside the canopy were measured at the time when the sprayer passed over the canopies. Air jet velocity profiles from nozzle outlets to 0.79 in below the nozzles were determined experimentally and mathematically. The measured air jet velocity decreased front 40.1 to 19.4 m/s when the distance from the orifice increased* from *0.33 to 0.79 The peak velocities at the top and middle elevations for both inside and outside the canopy decreased as the nozzle height above the ground increased, but the peak velocities at the bottom elevation for both situations were not significantly decreased as the nozzle height increased. The average period of time for dynamic air velocities higher than 1 m/s inside the canopy was 1.9 s at the bottom, 3.8 s at the middle, and 1.1 s at the top of canopies. The mean spray deposit inside taxis canopies with leaf area index of .5.96 increased in an exponential function as the peak air velocity increased. The spray penetration capability and spray deposition uniformity inside taxus canopies were greatly improved with the five-port air-assisted sprayer.*

Keywords. Dynamic air velocity, New sprayer, Nursery production, Pesticide, Spray deposition.

Due to the large number of species in nursery production, commercially available sprayers have limited capacity for treating specific nursery species. To control insects and diseases inside dense nursery canopies, existing spray techniques have used either excessive or inadequate pesticide delivery to target areas, resulting in increased cost and contamination of the environment. Sprayers commonly used for field crops are unable to deliver sufficient pesticide to the inner or lower parts of dense nursery canopies, where insects and diseases frequently attack. In many cases, high application rates are used to increase the amount of pesticide deposited inside dense canopies, but the spray deposits at the top of the plants are saturated. Due to limitation of proper pesticide delivery systems for dense nursery crops, large amounts of pesticide are wasted or improperly applied. Growers are seeking new sprayers or customized delivery systems that can operate economically and effectively with minimum canopy damage and optimum in pest control.

To be marketable, many nursery plants are required to have full canopy shapes from the top to the bottom near the ground. Therefore, applying pesticides in nursery crops requires extra care. Some research on spraying nursery stock has been conducted, but the literature on results of spray trials is limited. Spray deposition within nursery crop canopies varies significantly with type of sprayers and plant species. Bache and Johnstone (1992) noted that more precise knowledge of fungicide coverage and plant canopy penetration is required to maximize effectiveness of chemical and biological crop management strategies. Krause et al. (2004)

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