

In nurseries, plant pathogens can spread via water splash from the ground to container plants growing on benches. We used

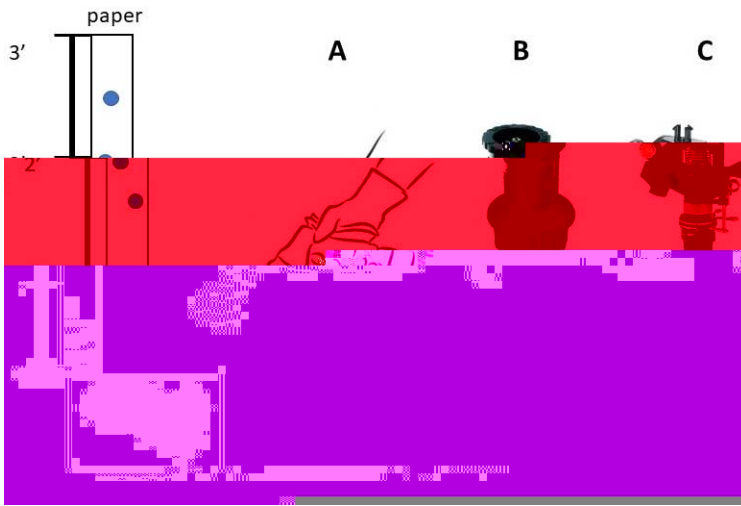


Figure 1. Detection of water splash on common nursery surfaces with three different irrigation types. Blotter paper was placed at a 90° angle to each surface and 200mL of a fluorescent suspension containing ~2 x10⁶ microspheres were poured onto the surface, 1-1.5' in front of the blotter paper. Each surface was watered using three different irrigation types, separately (A: Hand wand, B: Spray sprinkler, C: Impact spray).

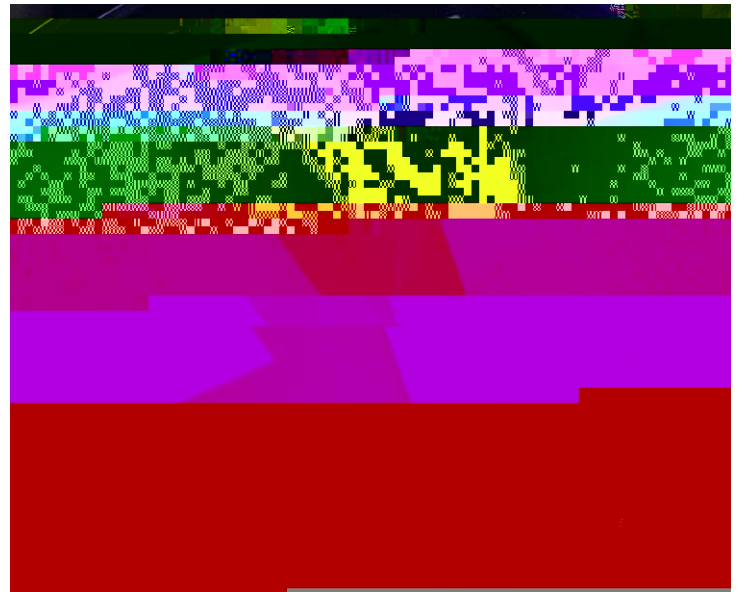


Figure 2. Detection of fluorescent microspheres on blotter paper using an UV-lamp.

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The suspensions, which contained approximately 2 million microspheres each, were poured onto the trial area at a distance of 1-1.5' to the blotter paper. The surfaces were watered with each of the irrigation systems separately for 30 seconds at an angle of 45-60°.

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All surfaces except concrete were also tested with the spray sprinkler and impact spray, and weed barrier fabric was the surface type from which water splashes were detected most commonly.

The extent of vertical water splash (defined as highest average splash and number of droplets at a given height) differs based on surface and watering type. The fluorescent microspheres used in the experiment had a diameter of 53–63 microns, resembling the size of propagules (sporangia: 46–65 x 21–28 μm, chlamydospores: 46–60 μm) and acted as surrogates for the spread of waterborne pathogens. Of the five surface types tested, concrete resulted in significantly higher droplet numbers above 2' when tested

with hand watering compared to bare soil, mud puddle, weed barrier fabric, and 3/4" gravel. Only a very small fraction of the microspheres used in the experiment was detected at a height of 2–3' above surface level using all three irrigation types and no droplets were observed between 2.5–3' when spray sprinklers were used. The spray sprinklers used in this experiment emitted significantly less water per minute than hand watering and impact spray (4 gal/min vs. 11 gal/min), which could explain some of the observed differences. However, the smaller droplet size released from the spray sprinkler resulted in a 'mist-like' irrigation pattern with decreased physical impact compared to the 'rain-like' irrigation typical for hand watering and impact spray. In laboratory experiments with

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Figure 3: Average number of water droplets from different surfaces using three different irrigation types. Left panel: results arranged by irrigation type (A: Hand wand, B: Spray sprinkler, C: Impact spray); right panel: results arranged by height (D: 1–2'; E: 2–2.5'; F: 2.5–3'). Bars with different letters are statistically significant at $P < 0.05$.

inoculum threshold of 51 zoospores/mL was reported for infecting detached rhododendron leaves (Rollins et al., 2015). Consequently, smaller droplet sizes and low numbers of droplets reaching 2' above surface reduce the risk of spreading waterborne pathogens.

Best Management Practices should be used in nurseries to produce healthy plants. We recommend to:

- o Place plants on raised benches at a height of 3' if possible (Figure 4)
- o Choose an irrigation type with small water droplet sizes and low pressure, preferably overhead; when watering with a hose, keep the water on the plants soil surface and avoid aiming the hose at the ground to reduce splashing
- o Choose a surface type which can be cleaned and drained easily, and from which droplets bounce back at reduced rates.

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Grünwald, N.J., M. Garbelotto, E.M. Goss, K. Heungens, and S. Prospero. 2012. Emergence of the sudden oak death pathogen *Phytophthora ramorum* in California. *Phytopathology* 20: 131-138.

IBM Corp. Released 2019 IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.

Pastalka, T., S. Rooney-Latham, K. Kosta, K. Suslow, V. Huffman, S. Ghosh,

Figure 4: The risk of water splash transmitted plant diseases can be reduced by placing plants on a bench above a graveled surface irrigated with spray sprinkler.