Efficacy of nano-encapsulated, commercially available orange oil to control Botrytis fruit rot

M. J. Gutierrez, L. C. Garner, J. Chen, L. Yang, S. Horner, Y. Feng, G. J. Holmes, and S. S. Hewavitharana

Essential oils can provide control of *Botrytis cinerea*, and slow resistance to major fungicide classes. However, low solubility and high volatility present challenges. Nano-encapsulation of essential oils may address these limitations by enhancing dispersibility and retention of volatile compounds, thus also providing longer residual protection. For this experiment, citrus was harvested from groves at Cal Poly San Luis Obispo, and the essential oils were extracted and characterized. A nano-encapsulation technique is currently being developed and optimized. The efficacy of nano-encapsulated, commercially available orange oil for the control of *B. cinerea* was evaluated through a field trial and a detached fruit bioassay.

Field trial

This experiment consisted of 4 beds with 7 plots per bed. Each plot was 20 ft long (64 plants per plot). Bare root 'Fronteras' transplants were planted on 31 Oct 2024. Blooms were tagged prior to the first spray, and all fruit was removed. Spray treatments began on 23 Apr 2025, and were applied weekly for 5 consecutive weeks using a backpack sprayer equipped with 8 hollow cone nozzles, calibrated to deliver 150 gal/A at 60 psi. Once fruit within the trial reached full ripeness, evaluations for Botrytis fruit rot incidence were conducted at-harvest and postharvest to assess treatment efficacy.

Detached fruit bioassay

Pink (half-ripe) 'Fronteras' strawberries were harvested and surface sterilized in a 0.5% bleach solution. Berries were dipped into a treatment for 1 sec, slightly wounded with a sterile toothpick infested with *B. cinerea* spores and incubated at room temperature for four days. Resulting lesions were measured and the percent inhibition of *B. cinerea* was calculated using the following equation:

$$\frac{Control - Treatment}{Control} \times 100 = Inhibition\ (\%)$$

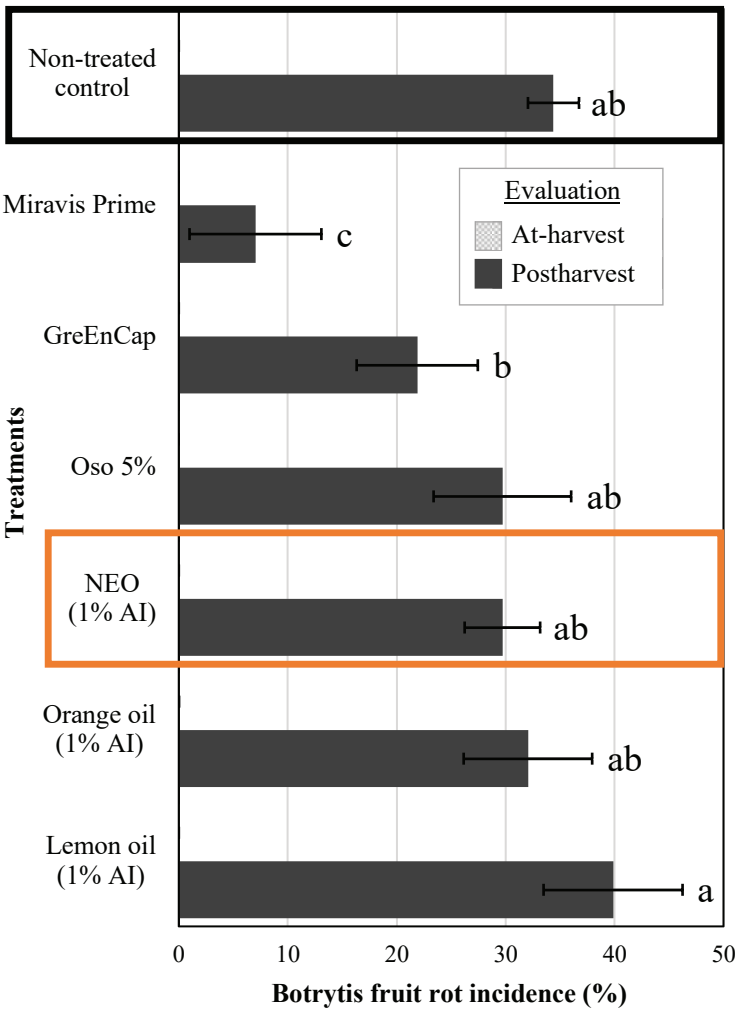

Figure 1. Botrytis fruit rot incidence at-harvest and four days postharvest. NEO = nano-encapsulated orange oil; AI = active ingredient. Fungicides were applied at max label rate. Data was subject to Fishers LSD mean separation. Error bars represent standard error of the means. Values not connected by the same letter are significantly different ($\alpha = 0.05$).

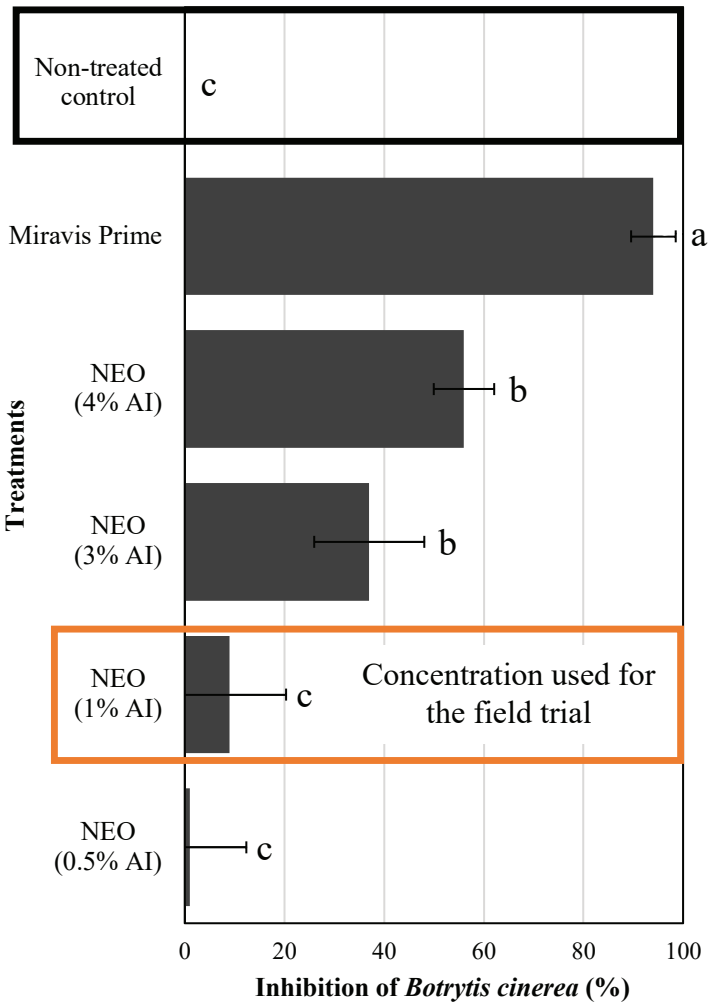

Figure 2. Percent inhibition of *Botrytis cinerea* on detached fruit, four days after treatment and inoculation. NEO = nano-encapsulated orange oil; AI = active ingredient. Fungicides were applied at max label rate. Error bars represent standard error of the means. Values not connected by the same letter are significantly different ($P < 0.05$).