Irrigation management: an inexpensive way of reducing bacterial rot of onion in the Columbia Basin of Washington State?

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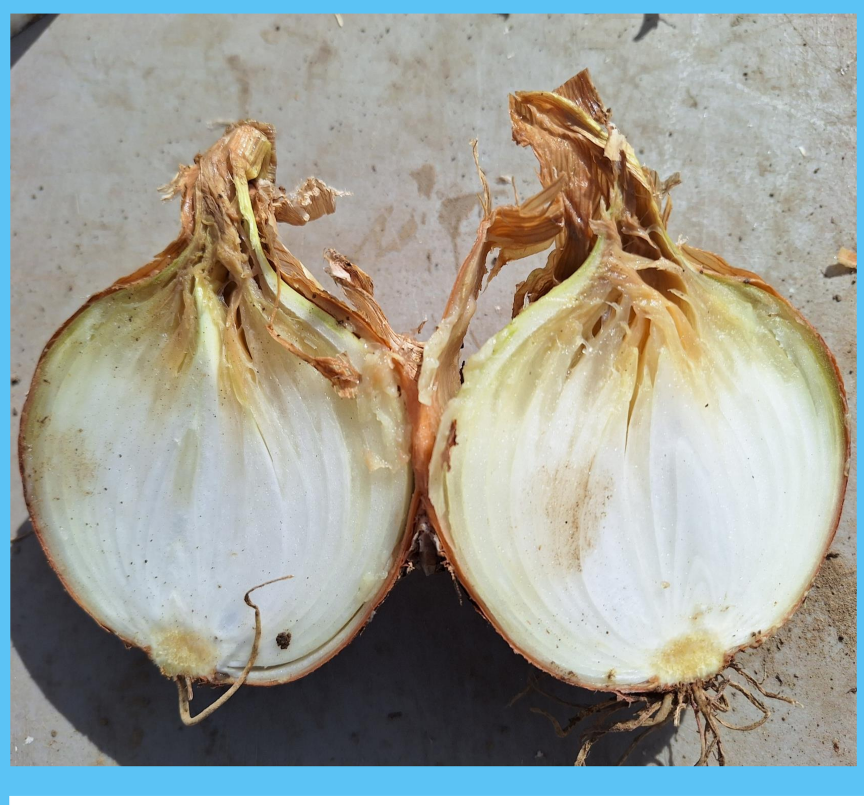
Introduction

- Onion bacterial diseases cause substantial crop losses (>$60 M annually) to the onion industry in the United States (AlliumNet, 2024).
- Chemical control options are not curative and largely have proven ineffective in the Columbia Basin of Washington State, shifting the focus to sound cultural management practices to prevent infection.
- Overhead irrigation increases the risk of bacterial bulb rots compared to drip irrigation as splashing water is a major pathway for introduction of soilborne plant pathogenic bacteria when water splashes soil containing bacteria onto the leaves and into the necks of onion plants (Belo et al., 2023; Wilson et al., 2024).
- Moisture entering the neck of the onion from overhead irrigation also keeps conditions conducive for bacterial growth on onion plants.
- With overhead irrigation, halting irrigation when the tops have just started to fall over as part of natural senescence ("tops down") has been shown to reduce the incidence of bacterial bulb rot relative to halting irrigation at 90% tops down (Belo et al., 2023).
- The influence of irrigation frequency throughout the season under sprinkler irrigation on onion bacterial bulb rots is less clear, and to our knowledge, has not been studied.

Hypothesis

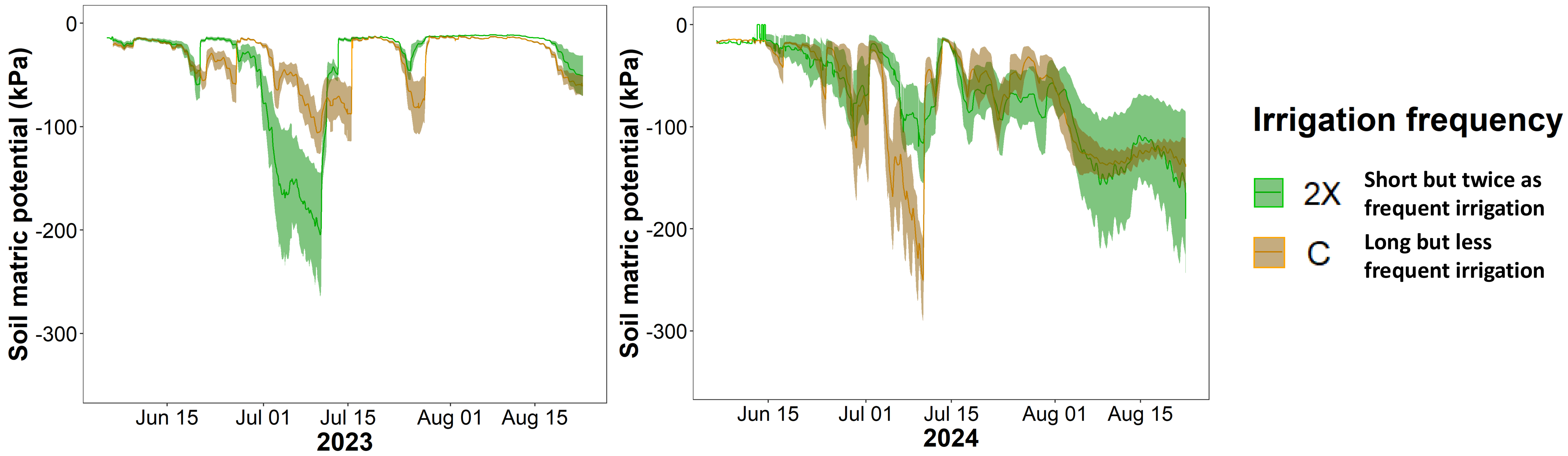
- If the same total amount water is applied to onions in short and frequent irrigations, the incidence of onion bacterial rot will be greater than if longer and less frequent irrigations are applied.

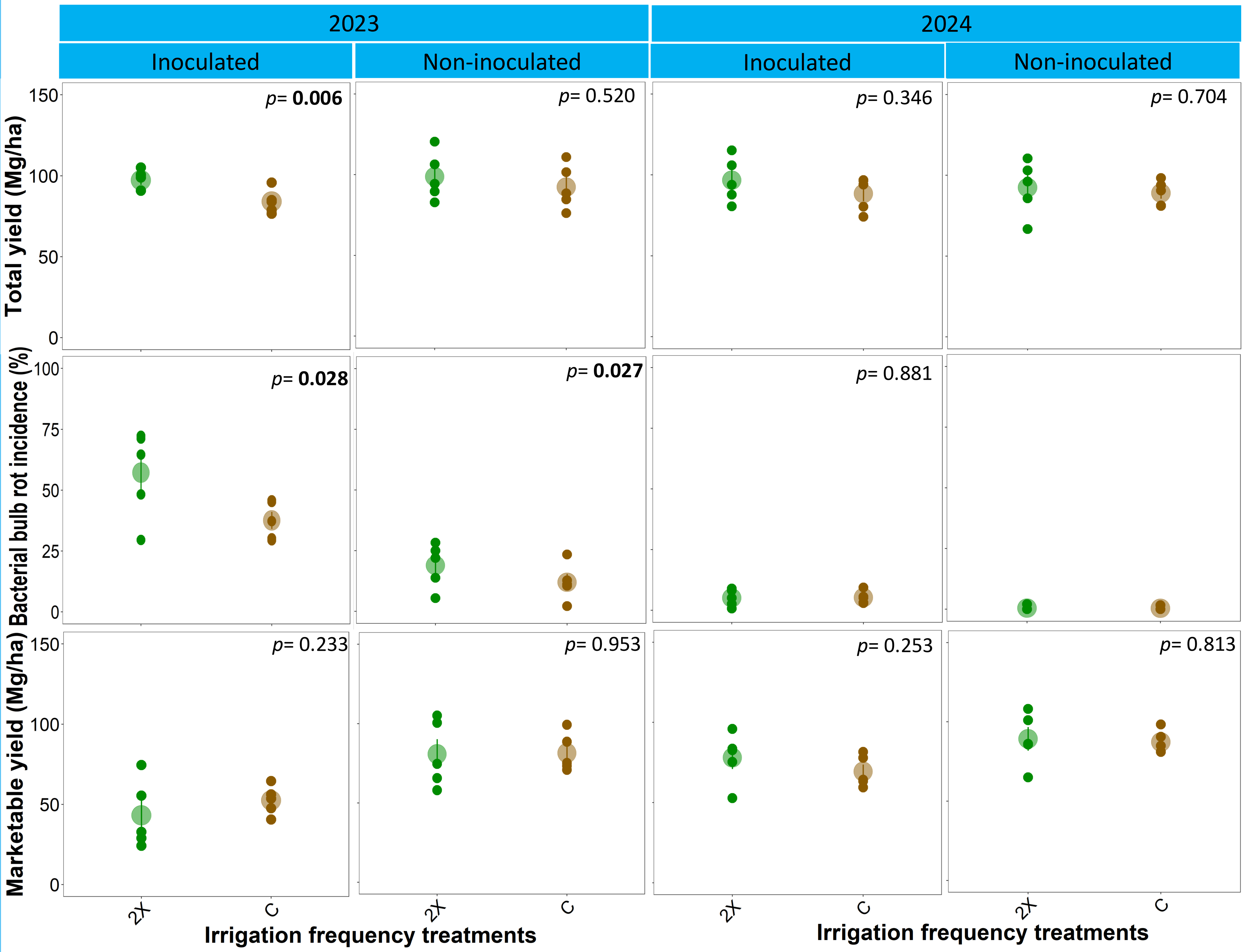


Materials and Methods

- **Study site and years:** Pasco, Washington, USA in 2023 and 2024
- **Cultivar:** Calibra
- **Experimental design:** Split-plot RCBD. Irrigation treatments were assigned to the main plots, and inoculation treatments were assigned to the split plots
  - The 2X irrigation frequency plots were irrigated twice as frequently as the control plots, but for half the duration each time
  - The inoculation treatments were inoculated or not inoculated with local strains of *Burkholderia gladioli* pv. *allicola*, the causal agent of slippery skin, and *Pantoea agglomerans*, the causal agent of center rot and bacterial leaf blight
- **Irrigation method:** The crop was grown with drip irrigation until the 3 to 4 leaf stage, and then with sprinkler irrigation for the rest of the season, using micro-sprinklers (MP-2000 Rotator, Hunter Industries) to simulate center pivot irrigation, and with at least 3-m-wide buffers between adjacent experimental plots
- **Soil moisture measurement:** Soil matric potential sensors (TEROS 21, METER Group, Inc.) were installed 6 inches deep in every plot and connected to a data logger
- **Inoculation:** Inoculum was applied immediately after irrigation, just before dark, at the approximate first sign of tops down and again at 50% tops down
- **Harvest:** Bulbs were harvested from a 1.5-m by 0.9-m section of every split plot
  - Culled bulbs were sorted into those culled due to bacterial bulb rot and those culled due to abiotic factors (e.g., basal-plate blowout) or rot caused by fungal pathogens
  - Apparently healthy bulbs were sorted into size classes and then put into commercial storage for five months at 1–2 °C and 75–80% relative humidity
- **Storage rating:** The stored bulbs were cut after five months of storage and rated for the incidence and severity of bacterial bulb rot (pending for the 2024 trial)
  - Bacterial bulb rot incidence (%) in 2023 includes both rotten bulbs at harvest and rotten bulbs after storage, while in 2024, only rotten bulbs at harvest are included (storage results pending)
  - The estimated marketable yield was calculated after storage analysis since the weight of the marketable bulbs was recorded at harvest but not after storage.

Results





Graph details:

- Small points are observations from individual plots, bigger points represent the mean, and the error bars are the standard error of the mean
- For 2023, the incidence of bacterial bulb rot and estimated marketable yield are assessed after storage, but for 2024 they have only been assessed at harvest
- *p*-values are based on an ANOVA (missing p-values mean that the data didn't meet the assumptions of an ANOVA)

Discussion

- Total yield was comparable or greater for onions grown with more frequent but shorter irrigation events (2X plots) compared to total yield in plots with longer, less frequent irrigation (C plots).
- More frequent irrigation increased bacterial bulb rot incidence, particularly after storage.
- Ultimately, this eliminated any benefit of the more frequent irrigation and resulted in similar marketable yield.
- Growers can manage irrigation to reduce the risk of bacterial bulb rots while avoiding water stress that limits yield.

Conclusion

Longer and less frequent irrigation can reduce losses to bacterial bulb rots without reducing marketable yield

Acknowledgment

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