Onion (*Allium cepa* 'Calibra')
Slippery skin; *Burkholderia gladioli* pv. *allicola*
Center rot; *Pantoea agglomerans*

S. Thapa, L.J. du Toit, M.L. Derie, B. Schacht, and G.T. LaHue, Washington State University (WSU) Mount Vernon NWREC, Mount Vernon, WA 98273; and T.D. Waters, WSU Benton & Franklin Co. Extension, Pasco, WA 99301.

Effects of irrigation frequency on onion bacterial bulb rot in the Columbia Basin of Washington State, 2023-24.

A trial was conducted in Pasco, WA to investigate the effect of irrigation frequency on the incidence of onion bacterial leaf blight and bulb rot under sprinkler irrigation. The soil was a Quincy loamy fine sand with a pH of 8.0 and 1.0% organic matter. The trial was arranged as a 2-by-2 factorial randomized complete block design with split plots and five replicates. Two irrigation frequency treatments were assigned to the main plots, and two inoculation treatments, inoculated or not inoculated with plant pathogenic bacteria, were assigned to the split plots. Plots receiving the control irrigation treatment were irrigated based on standard local practices, while plots receiving the 2X treatment were irrigated twice as often but for half the duration each time for the same total amount of water applied to the two irrigation treatments. Irrigation treatments were started after plants had three to four true leaves. The trial was sown with the seed of 'Calibra' on 6-m-long and 1.7-m-wide raised beds, with adjacent beds separated by a buffer of at least 3 m. Soil matric potential and soil temperature were recorded in each plot using TEROS 21 soil matric potential sensors placed at a 15 cm depth, and readings were logged every 15 minutes using ZENTRA ZL6 data loggers (METER Group, Inc., Pullman, WA). For inoculation, the 6-m-long main plots were divided into two 2.4-m-long split plots with a 1.2-m-long buffer between the split plots. Inoculation was performed at the first sign of tops down (3 Aug 23) and two weeks later (17 Aug 23) with a mix of one local strain each of *B. gladioli* pv. *allicola* and *P. agglomerans* at a rate of 10^8 cfu/ml, using a CO_2-pressurized backpack sprayer, avoiding the drift of inoculum to the non-inoculated plots. The field was irrigated briefly before each inoculation, and inoculation was carried out in the evening to facilitate infection. Irrigation was stopped at 50% tops down. Onions were undercut on 30 Aug 23 and left for 2 weeks to cure in the field before harvest on 12 Sep 23. Bulbs were harvested from a 1.5-m-long section of each plot from half of the bed width (2 double rows of onions from the 4 double rows sown per bed). Unmarketable bulbs (culls) were categorized as bacterial culls and other culls (culled due to basal plate blowout, etc.). The remaining marketable bulbs were categorized based on size as prepack (<5.7 cm diameter), medium (5.7-7.6 cm), jumbo (7.6-10.2 cm), and colossal (>10.2 cm). The incidence (%) of bacterial culls was recorded, and all culled bulbs were cut from the neck to the basal plate through the center of the bulb to rate the severity of cut surface area with bacterial rot symptoms as: 0, 1-20, 21-40, 41-60, 61-80, or 81-100%. The bacterial rot severity index was then calculated as a weighted average based on the midpoint of each categorical rating multiplied by the number of bulbs in a category. All marketable onions were stored for 5 months in a commercial storage facility at 1-2°C and 75-80% relative humidity. The bulbs were then sliced through the center from the neck to the basal plate and rated for the incidence (%) and severity of bacterial rot. The data were subjected to analysis of variance using R studio v. 4.2.2. The project was funded by Specialty Crops Research Initiative Award 2019-51181-30013 of the USDA National Institute of Food and Agriculture and the Washington Commission on Integrated Pest Management.

There was no significant interaction between the inoculation and irrigation frequency treatments ($p > 0.05$). Nevertheless, results were analyzed separately for inoculated and non-inoculated plots to better understand the effects of these treatments under high and low disease pressure. Inoculation increased the incidence of bacterial bulb rot by 41% and decreased marketable yield by 41%. The bacterial bulb rot incidence averaged between the irrigation treatments was 15% in non-inoculated plots vs. 47% in inoculated plots. Total yield did not differ between irrigation treatments in non-inoculated plots ($p = 0.520$) but was 16% greater in inoculated plots that received the 2X irrigation treatment than in inoculated plots receiving the control treatment ($p = 0.006$). No difference in the incidence of bacterial culls was detected between irrigation frequency treatments at harvest in either non-inoculated or inoculated plots. However, the incidence of bacterial bulb rot after 5 months in storage was 54 and 52% greater for the 2X irrigation treatment in non-inoculated ($p = 0.026$) and inoculated plots ($p = 0.028$), respectively, than for the control treatment. No difference in the severity of bacterial bulb rot was observed between irrigation frequency treatments at harvest. After 5 months in storage, disease severity was 73% greater in inoculated plots subjected to the 2X irrigation treatment than in those subjected to the control treatment but did not differ between irrigation treatments in non-inoculated plots. To summarize, applying the same total amount of irrigation in more frequent but shorter irrigation events increased the incidence of bacterial bulb rot compared to irrigation applied less frequently for longer durations. This increase in bacterial bulb rot counteracted any increase in total yield with increasing irrigation frequency, ultimately leading to no difference in marketable bulb yield. Therefore, short and frequent irrigation should be avoided in areas or conditions associated with high bacterial disease pressure to reduce losses to bacterial bulb rot and maintain or improve marketable yield.

Inoculation treatment	Irrigation frequency treatment	Bulb weight (Mg ha^{-1})			Bacterial bulb rot (%)		Bacterial bulb rot severity index[z]	
		Total yield	Bacterial culls at harvest	Marketable yield after storage[y]	Culls at harvest	At harvest plus after storage	At harvest	At harvest plus after storage
Non-inoculated	Control	92.3 ± 6.2[x]	1.2 ± 1.2	81.4 + 5.4	2.1 ± 2.1	12.0 ± 3.4 **b**	1.0 + 1.0	6.1 + 2.3
	2X	98.7 ± 6.7	2.3 ± 0.6	80.8 + 9.4	2.7 ± 0.7	18.5 ± 4.0 **a**	0.9 + 0.3	9.5 + 1.8
	p-value	0.520	0.345	0.953	0.271[y]	**0.026**	0.399[w]	0.098
Inoculated	Control	84.0 ± 3.3 **b**	12.9 ± 2.1	52.5 + 4.0	15.2 ± 1.9	37.4 ± 3.5 **b**	8.0 + 2.2	20.0 + 3.1 **b**
	2X	97.2 ± 2.8 **a**	25.4 ± 7.3	43.1 + 9.5	27.8 ± 7.4	56.8 ± 8.0 **a**	13.9 + 3.9	34.5 + 4.5 **a**
	p-value	**0.006**	0.174	0.233	0.175	**0.028**	0.260	**0.010**

[z] The bacterial rot severity index was calculated by rating the area of the cut surface of each bulb (cut through the center from the neck to the basal plate) as 0, 1-20, 21-40, 41-60, 61-80%, or 81-100% rotten, and then calculating a weighted average based on the midpoint of each categorical rating and the number of bulbs in each category.
[y] Estimated marketable yield, calculated as the product of marketable yield at harvest and the percent of stored bulbs with no bacterial rot after 5 months in storage.
[x] Mean ± standard error.
[w] *p* values from a square root transformation that satisfies the assumptions for the analysis of variance.