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

L. J. du Toit, M. L. Derie, B. Gundersen, Washington State University Mount Vernon NWREC, Mount Vernon, WA 98273; T. D. Waters and J. Darner, Washington State University Benton & Franklin Counties Extension, Pasco, WA 99301.

Efficacy of disinfectants applied to onion bulbs in storage for control of bacterial bulb rots, Pasco, WA, 2020-2021.

A trial was completed at the Washington State University Pasco Vegetable Extension Farm using pelleted seed of the cv. Calibra to evaluate the effects of applying disinfectants to onion bulbs in storage, immediately after harvest, for management of bulb rots caused by *Pantoea agglomerans* and *Burkholderia gladioli* pv. *alliicola* in the Columbia Basin of Washington and northcentral Oregon, where 24,000 A of storage onion crops are grown annually. The trial was a split plot, randomized complete block design with five replications of a factorial treatment design of two inoculation treatments (inoculated or not inoculated with the bacterial pathogens) applied to main plots, and six postharvest disinfectant treatments applied to bulbs harvested from split plots: Jet-Ag, StorOx 5.0, Sanidate, ozone, and two control treatments, one in which bulbs were thermofogged with water, and a second with non-treated bulbs. Each split plot was one 34-in.-wide bed (with 2 double-rows of onion plants) x 15 ft long, including 5 ft of bed as a buffer between the ends of adjacent plots. Inoculum consisted of an equal ratio of the two pathogens, each produced as overnight shake cultures in nutrient broth and diluted to 10^8 CFU/ml in 0.01M phosphate buffer. Inoculum was applied in the evening at 10^8 CFU/ml on 30 Jul (5% tops down) and 13 Aug (50% tops down) with a CO_2-presurized backpack sprayer and 3-nozzle boom (XR8003 tips, 32.8 gpa, and 20 psi). The trial was irrigated by center-pivot and managed using typical practices for the Columbia Basin. The plants also were irrigated with 0.12 in. of water in the late afternoon every other day from mid-Jul through Aug to favor bacterial infection. All plots were undercut on 26 Aug. (100% tops down) with a tractor-mounted rod-weeder. Fifty bulbs were harvested from each split plot on 15 Sep and placed in a mesh bag. The post-harvest disinfectant treatments were each applied to five replicate bags of 50 bulbs from inoculated plots and five replicate bags of bulbs from non-inoculated plots in a steel shipping container (1,200 cubic ft) modified by IVI, Inc. (Pasco, WA) to simulate a commercial storage facility. A thermofogging equipment trailer used by IVI, Inc. to treat onions in commercial storage units was used to apply each of the three formulations of hydrogen peroxide + peroxyacetic acid (Jet-Ag, StorOx 5.0, and Sanidate) to the bulbs by thermofogging. Each product was mixed with water (24 fl oz water + 24 fl oz product) and dripped at a rate of 8 fl oz/min onto a metal plate heated to 750°F with propane. The vaporized product (thermofog) was pushed into the storage container by a blower, and through a plastic pipe beneath a perforated bin containing the 10 bags of onion bulbs. Application of each product took 60 min, after which the air was circulated inside the sealed container for 8 hr using a small fan. The container was then aerated, and the bags of onions moved to a commercial storage facility (40°F, 70% relative humidity). A video of the application process is at https://youtu.be/VSExAvjJAT8. For the thermofog control treatment, 48 fl oz of water was thermofogged for 60 min and circulated for 8 hr in the sealed container, as described above, with bulbs then placed in storage. The ozone treatment was applied with an HE 500 Commercial Ozone Generator operated inside the storage container near a circulating fan for 8 hr to deliver 8,500 mg ozone per hr. The container was then aerated, and the bags of onions moved to a commercial storage facility. The second control treatment consisted of 5 bags of bulbs from each of inoculated and non-inoculated plots placed in storage without treatment. Bulbs harvested from inoculated and non-inoculated plots were placed in an additional 5 replicate bags shortly after harvest (pre-storage) to rate for bacterial bulb rots by cutting each bulb vertically and rating the incidence (percentage of bulbs with symptoms) and severity (percentage of the cut bulb surface area with symptoms) of internal bacterial rot pre-storage. On 26 Feb 21, after 5 months in storage, the bulbs in each bag were cut and rated for incidence and severity of bacterial bulb rot. Data were subjected to analyses of variance (ANOVAs) and means comparisons using Fisher's protected least significant difference (LSD, $P < 0.05$), with relevant transformations necessary for parametric analyses.

The mean incidence of bacterial rot in non-treated bulbs harvested from inoculated and non-inoculated plots was 27.1 ± 2.4% and 0.8 ± 0.5%, respectively ($P < 0.0001$), and severity of bacterial rot was 13.7 ± 1.3% and 0.4 ± 0.3%, respectively ($P < 0.0001$). For bulbs not treated with a disinfectant, there was no difference in incidence or severity of bacterial rot pre-storage vs. post-storage ($P = 0.6342$ and 0.4608, respectively, *data not shown*). After 5 months in storage, the incidence of bacterial rot for bulbs harvested from inoculated plots vs. non-inoculated plots was 28.8 vs. 1.7%, respectively, and severity of rot was 15.2 vs. 0.7%, respectively. There was no significant effect of disinfectant treatments on incidence or severity of bacterial bulb rot, and the interaction inoculation treatments with disinfectant treatments was not significant for either variable. For bulbs harvested from inoculated plots, none of the postharvest disinfectant treatments reduced the incidence or severity of bacterial rot in storage compared to that of non-treated bulbs. The results indicate there is no benefit to applying ozone or hydrogen peroxide + peroxyacetic acid products to onions in storage for managing bacterial rots, probably because the products cannot penetrate the dry wrapper scales.

Main plot and split plot treatments	Bacterial bulb rot after 5 months in storage	
	Incidence of bulbs (%)	Severity per bulb (%)
Main plots		
Inoculated	28.8 a[z]	15.2 a
Non-inoculated	1.7 b	0.7 b
LSD	Rank[y]	Rank
ANOVA *P* value	0.0001	0.0001
Split-plots		
Jet-Ag	30.8[x]	15.8[x]
StorOx 5.0	28.2	16.4
Sanidate	27.4	15.0
Ozone	29.8	15.4
Non-treated	27.8	13.2
LSD	15.8	9.3
ANOVA *P* value	0.9888	0.9587

[z] For inoculation treatments and disinfectant treatments, means within a column followed by the same letter are not significantly different based on Fisher's protected least significant difference (LSD). If the F-test in the ANOVA was not significant, means separation letters are not shown.

[y] 'Rank' = data subjected to Friedman's non-parametric rank test to meet assumptions for parametric analyses. Original means are shown but means separation is based on the transformed analysis.

[x] Mean ratings for the disinfectant treatments are shown only for inoculated plots because of a significant inoculation effect for incidence and severity of bacterial bulb rot (P <0.0001 for both variables), very little infection in bulbs harvested from non-inoculated plots, and no significant interaction of inoculation treatments with disinfectant treatments (P = 0.8226 and 0.9687 for incidence and severity ratings, respectively, in the ANOVAs).