DRY BULB ONION (*Allium cepa* 'various')
Bacterial bulb decay; *Burkholderia cepacia, Pantoea ananatis*, *P. agglomerans*

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Variety evaluation and effect of copper bactericide on bacterial bulb rot in onion, 2020.

Two trials were conducted in a commercial onion field in 'muck' soil in Elba, NY. One trial relied on natural bacterial infection, while the other was artificially inoculated. Application of copper bactericide was evaluated across fourteen onion varieties for bulb rot. The trials were set up as a strip-plot design with variety as the main plot and protection as the strip-plot, with four replications. Both trials were seeded using a Stan Hay precision push seeder on 28 Apr, into plots that were two 2-row onion beds 5-ft in width and 25-ft in length, with onion rows spaced 10-in. and 20-in apart on the bed and between beds, respectively. For artificial bacterial inoculation the varieties were separated into three cohorts with five varieties with 95-105 days to maturity in the first cohort, six varieties with 107-112 days to maturity in the second cohort and three varieties with 118-120 days to maturity in the third cohort. At early lodging, on 6, 12 and 25 Aug for first, second and third cohorts, respectively, using a manual backpack sprayer, onions were sprayed to runoff with a mixture of 10^6 cfu/ml each of *Pantoea ananatis* and *P. agglomerans* at dusk during calm conditions to encourage leaf moisture through the night to favor bacterial disease. Badge SC 2 pt/A was applied to the back 10-ft of each plot in both trials with a CO_2-pressurized backpack sprayer at 40 gpa and 30-33 psi using three TeeJet 8005 VS flat fan nozzles spaced 19-in. apart. Copper bactericide application was initiated when leaves started to senesce and continued every 5-9 days for three applications prior to and two (one in first cohort) applications after artificial bacterial inoculation. Maturity measured by % lodging/plot was visually estimated in each variety per cohort prior to artificial bacterial inoculation. When all varieties were 100% lodged, approximately 160 bulbs/plot were harvested including from copper-treated and non-treated plots in naturally infected and artificially inoculated trials on 24 and 25 Sep, respectively. Onions were stored in mesh bags in an open-sided barn until they were moved indoors to an unheated barn on 29 Oct. They were topped and inspected for rot on 3-12 Nov and 13 Nov-1 Dec for the natural and artificially inoculated trials, respectively. All soft bulbs were cut open to confirm presence of bacterial bulb rot. Additionally, a sub-sample of 30 seemingly healthy bulbs/plot were also cut open and inspected for bacterial rot; the percentage of bulb rot in this sample was extrapolated to the remaining healthy bulbs. Significant differences among treatments were determined by Strip-Plot Analysis of Variance with protection as the main-plot factor and variety as the sub-plot factor, and Fisher's Protected Least Significance Difference test with 5% significance.

May 2020 broke records for both low and high temperatures, while June through September had above normal temperatures with July breaking the record. Rainfall was slightly above average in May and July and below average in June and September with > 1-in. rainfall occurring once/month in April to August. In each trial, variety was significant, protection (copper vs. non-treated) was insignificant and there was not a significant interaction between variety and protection for bulb rot. Consequently, bulb rot was pooled across protection in each trial. In both trials, plots treated with copper bactericide had either more or less bulb rot than their non-treated counterparts by an average of 33% in seven (50%) and five (36%) of the varieties in the natural and artificially inoculated trials, respectively (data not shown). Effect of copper bactericide on bulb rot was opposite between trials for nine (64%) of the varieties (data not shown). In the naturally infected trial, Bradley had the lowest bulb rot (3.3%), which was significantly lower than the variety with the highest bulb rot, Ridgeline (18.3%). In the artificially inoculated trial, Stanley had the lowest bulb rot (7.1%), which was significantly lower than the variety with the highest bulb rot, Saddleback (21%). In both trials, Bradley, Stanley and Hamilton were consistently not significantly different than the variety with the least bulb rot, while Saddleback, Ridgeline, Trailblazer, SVNY1298 and Montclair were consistently not significantly different than the variety with the most bulb rot. In the naturally infected trial, Pocono and SVNY1141 were also not significantly different than variety with the least bulb rot, while Red Wing and Braddock were also not significantly different than the variety with the most bulb rot. Similarly, in the artificially inoculated trial, Braddock, Catskill and Red Wing were not significantly different than the variety with the least bulb rot, while Red Mountain and SVNY1141 were not significantly different than the variety with the most bulb rot. The naturally infected and artificially inoculated trials averaged 10.3% and 13.4% bulb rot, respectively (data not shown). Bulb rot was numerically higher in the artificially inoculated trial than in the naturally infested trial in nine (64%) of the varieties with greater than 50% more bulb rot in Bradley, SVNY1141, Saddleback, SVNY1298, Pocono and Red Mountain. Bulb rot was the same or lower in the artificially inoculated trial than in the naturally infected trial in Ridgeline, Montclair, Braddock and Red Wing. There were no consistent trends between maturity at time of artificial inoculation, as measured by % lodging, or inoculation cohort and varietal response to artificial inoculation. For example, in two varieties where bulb rot was 2-times higher in the artificially inoculated trial compared to the naturally infected trial, Bradley and Saddleback belonged to different inoculation cohorts (Bradley: 3rd; Saddleback: 1st) and had significantly different lodging at time of inoculation (Bradley: 8.2%; Saddleback: 38.8%). Additionally, there were also no trends found between bulb rot and maturity, and plant growth characteristics including leaf architecture, plant vigor and neck diameter (data not shown).

Variety (in order of days to maturity)[z]	Days to Maturity[z]	Natural Bacterial Bulb Rot[y] % 3-12 Nov	Artificially Inoculated Bacterial Bulb Rot[y] % 13 Nov-1 Dec	Lodging at Time of Artificial Inoculation % 6, 12, 25 Aug
			1st Inoculation Cohort (6 Aug):	
SVNY1298	95	10.7 a-d[x]	19.3 ab	7.0 bc
Trailblazer	100	16.3 ab	20.9 a	40.0 a
Saddleback	100	11.0 a-d	21.0 a	38.8 a
Catskill	105	9.3 b-e	10.2 c-f	6.6 bcd
Stanley	105	4.9 ef	7.0 f	4.5 bcd
			2nd Inoculation Cohort (12 Aug):	
Braddock	107	10.6 a-d	9.9 c-f	4.2 bcd
Ridgeline	107	18.3 a	13.7 a-d	12.0 b
Red Mountain	107	9.9 b-e	16.0 a-d	1.7 d
SVNY1141	110	7.4 def	15.8 abc	5.7 bcd
Pocono	110	7.4 c-f	12.2 b-e	2.7 bcd
Montclair	112	14.3 abc	13.9 a-d	2.0 cd
			3rd Inoculation Cohort (25 Aug)	
Bradley	118	3.3 f	7.1 ef	8.2 bc
Hamilton	120	6.0 def	8.7 def	2.3 cd
Red Wing	120	10.6 bcd	10.6 c-f	6.0 bcd
p value (α=0.05)		0.0004	0.0006	<0.0001

[z] Order of days to maturity according to seed companies. In this study, NYSV1298, Stanley and Red Mountain matured later than, while Ridgeline and SVNY1141 matured earlier than their designated days to maturity.
[y] Variety was significant, protection was not significant and there was no significant interaction between variety and protection for bulb rot in either trial. Therefore, results for variety are pooled across protection. For the first cohort, Badge SC 2 pt/A was applied on 21 Jul, and 1 pt/A on 28 Jul, and 5, 10 Aug. For second cohort, Badge SC 1 pt/A was applied on 28 Jul and 5, 10 Aug, and 2 pt/A on 19, 24 Aug. For third cohort, Badge SC 1 pt was applied on 10 Aug and 2 pt/A on 19, 24, 31 Aug and 6 Sep.
[x] Numbers in a column followed by the same letter are not significantly different, Fisher's Protected Least Significant Difference Test ($p > 0.05$).