MPB 2019 Research Report:
Impact of Post-harvest Phosphorous Acid Treatment on the Incidence of Soft Rot Disease (yr 2/2)

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The primary objective of this study was to quantify differences in soft rot disease prevalence after several months in storage for tubers that were treated post-harvest with phosphorous acid versus those not treated. This study was conducted for a second year in order to determine if there would be year-to-year variability in the results.

In August 2019, our lab isolated bacteria that were indicative of soft rot bacteria by producing pitting on CVP plates and PCR tested positive for *P. parmentieri*. Bacterial cultures from these isolates were used in this study to inoculate tubers deployed in storage in order to test incidence of disease distribution under various treatments.

On September 27, 2018 two storage bins at the Aroostook Farm were filled with approximately 300-400 cwt. of the cultivar, Dark Red Norland. Bin 2 was filled without post-harvest tuber treatment while bin 1 was filled with tubers treated with a post-harvest treatment of Phosphorous Acid (57% mono and di-potassium phosphite), at a product rate of 12.8oz Rampart per ton, applied in total volume of 0.5gal/ton. Treatment was applied on the bin piler with an overhead spray bar with 4 nozzles. The average pulp temperature was 53°F and the pile height was 9-9.5 feet.

At the completion of bin-filling, ventilation (approx. 1.25 CFM/cwt) was initiated. Humidity and temperature were maintained at levels of 98% RH and 55F respectively for a three week curing period. After the curing period, bin temperatures were lowered by 0.5F/day, to a holding temperature of 45F, and humidity maintained at 98% RH.

Each bin contained three experimental treatments consisting of 50 tubers per mesh onion bag. Treatments consisted of 2%, 4%, or 0% (negative control) disease incidence that was accomplished with diseased tubers that were inoculated in the lab from the cultures obtained during the summer. Each treatment was replicated 5 times, so a total of 15 bags were deployed in each bin. Tubers were deployed in both bins on 10/1/2019.

Storage bins and treatment bags were assessed on day 14 (10/15/19), 43 (11/12/19), and 72 (12/11/19) for soft rot infections. The data was analyzed with ANOVA, and mean comparisons were conducted using Tukey's HSD, P=0.05. From the first assessment date, tubers in both bins were quite dry. This was in contrast to the previous year, where tubers treated with phosphorus acid remained noticeably damp for almost 2 months after storage began. Last year, the rate of infection was higher in the treated tubers as long as they remained wet or damp. Once they dried out, the rate was not significantly higher than the rate in the untreated tubers that were dry and not wet.

Results for this year are presented below:

At Day 14, the infection rate was similar to the rate when tubers were deployed, which indicates disease had not spread to surrounding tubers. There was no significant difference in infection rate between treated and non-treated tubers.

Mean Percent Active Infections (% of 50 Tubers)

Treatment	Inoculated Tubers (% of 50 Tubers) 0	2	4	
Phos. Acid (14 DAI)	0c[x]	2b	4.0a	**2.0A[y]**
None (14 DAI)	0c	2b	3.6a	**1.9A**
	0*[z]	**2****	**3.8*****	

x. Means followed by the same lower-case letter
are not significantly different, Tukey's HSD, P=0.05.
y. Means followed by the same upper-case letter
are not significantly different, Tukey's HSD, P=0.05.
z. Means followed by the same number of (*)
are not significantly different, Tukey's HSD, P=0.05.

At Day 43, the overall infection rate decreased in both bins due to disease in some inoculated tubers drying up and becoming non-active. The disease was not spreading to adjacent tubers.

Mean Percent Active Infections (% of 50 Tubers)

Treatment	Inoculated Tubers (% of 50 Tubers) 0	2	4	
Phos. Acid (43 DAI)	0a[x]	1.2a	2.4a	**1.2A[y]**
None (43 DAI)	0a	0.8a	1.2a	**0.7A**
	0*[z]	**1.0***	**1.8****	

x. Means followed by the same lower-case letter
are not significantly different, Tukey's HSD, P=0.05.
y. Means followed by the same upper-case letter
are not significantly different, Tukey's HSD, P=0.05.
z. Means followed by the same number of (*)
are not significantly different, Tukey's HSD, P=0.05.

By Day 72, the starting rates of 2% and 4% had both declined to a mean rate of 1%. Again, there was no significant difference of infection rate between treated and untreated tubers

Mean Percent Active Infections (% of 50 Tubers)

	Inoculated Tubers (% of 50 Tubers)			
Treatment	0	2	4	
Phos. Acid (72 DAI)	0a[x]	1.2a	1.2a	**0.8A[y]**
None (72 DAI)	0a	0.8a	0.8a	**0.5A**
	0*[z]	**1.0****	**1.0****	

x. Means followed by the same lower-case letter
are not significantly different, Tukey's HSD, P=0.05.
y. Means followed by the same upper-case letter
are not significantly different, Tukey's HSD, P=0.05.
z. Means followed by the same number of (*)
are not significantly different, Tukey's HSD, P=0.05.

The trend to report is that there was no significant difference in rate of infection between treatments during 2018 when all tubers appeared to be very dry within 14 days after storage began. However, in 2017 the treated tubers had a significantly higher rate of infection than the untreated at day 52 after storage began, but not at day 82 when the treated tubers had dried out as much as the untreated.

As observed in this study, one of the key management factors for controlling soft rot incidence, and likely tuber contamination, is adequate ventilation rates. The speed in which a farm manager is able to rid a potato pile of excess moisture is likely a contributing factor to overall soft rot and contamination rates. (Bartz and Kelman 1985, 1986). Sufficient and timely ventilation likely desiccates and destroys bacteria that are at least superficially adhered to the potato surfaces (Van Vuurde and De Vries 1994).

Our lab is also in the process of a peel contamination assay on tubers that were deployed in storage for this study as well as next-gen sequencing of tuber peel bacterial and fungal communities to determine if community composition is impacted by the application of phosphorus acid. The report will be updated when these objectives are completed.

Works cited:

Bartz, J. A., & Kelman, A. (1986). Reducing the potential for bacterial soft rot in potato tubers by chemical treatments and drying. *American potato journal*, *63*(9), 481-493.

Bartz, J. A., & Kelman, A. (1985). Effect of air-drying on soft rot potential of potato tubers inoculated by immersion in suspensions of Erwinia carotovora. *Plant disease (USA)*.

Van Vuurde, J. W. L., & De Vries, P. M. (1994). Population dynamics of Erwinia carotovora subsp. atroseptica on the surface of intact and wounded seed potatoes during storage. *Journal of Applied Bacteriology*, *76*(6), 568-575.