PHOSPHOROUS ACID EFFICACY ON STORAGE DISEASE CONTROL

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Despite every grower's best effort to grow and harvest a healthy and sound potato crop, there are several diseases that can cause mild to severe crop losses once the potatoes are in storage. A recently registered fungicide, considered a biofungicide, is phosphorous acid (Phostrol™; Fosphite™) which is applied as a spray going into storage for control of pink rot and late blight in storage. University of Idaho initiated this novel idea of a post-harvest application of phosphorous acid products to potatoes with extremely successful results. Numerous studies of ours have evaluated phosphorous acid, primarily Phostrol™, where tubers were inoculated with zoospores of the late blight and pink rot pathogens, and then treated with various products simulating a low-volume (0.5 gallon/ton tubers) post-harvest spray.

SMALL SCALE STUDIES

In one of our small storage studies, Phostrol™ and hydrogen peroxide/peroxyacetic acid (HPPA; Oxidate™) were applied one hour after inoculation with the pink rot pathogen. Phostrol™ was very effective at concentrations as low as 0.85 fl. oz/ton in reducing both the incidence and severity of pink rot development in storage (Table 1). An HPPA application was somewhat effective on reducing the severity of the disease compared to the control, but did not help in suppressing pink rot disease development.

Table 1. Efficacy of Phostrol™ on pink rot incidence and severity using washed tubers.[1]

Treatment (rate/ton tubers)	Incidence*	Severity**
UTC	84.7 a	62.8 a
HPPA (1:50 dilution)	75.3 a	34.7 b
Phostrol (1:75 dilution, 0.85 fl. oz.)	25.9 b	12.9 c
Phostrol (1:50 dilution, 1.28 fl. oz.)	20.0 bc	8.8 cd
Phostrol (1:40 dilution, 1.6 fl. oz.)	8.4 bc	8.8 cd
Phostrol (1:20 dilution, 3.2 fl. oz.)	0.0 c	0.0 d
Phostrol (1:10 dilution, 6.4 fl. oz.)	5.0 bc	2.5 d

[1]Values in the same column followed by the same letter are not significantly different.
*Percentage of inoculated tubers developing symptoms of disease. Analysis performed on arcsin value. Back transformed value given in the table.
**Average tuber area affected. Only tubers showing symptoms of disease were used for this assessment (healthy tubers not included).

A non-registered fungicide, Zoxamide, also is highly effective against pink rot and late blight but only if applied relatively soon after inoculation occurs. A study that looked at

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the interval between inoculation and treatment showed that HPPA needed to be applied within 4 hours of inoculation for a 30% reduction in late blight (Table 2) and applied immediately for a 45% reduction in pink rot (data not shown). Zoxamide applications were more effective than HPPA on late blight whereas Phostrol™ applications showed excellent control for both pink rot and late blight even 6 hours after inoculation. These studies stress the importance in timing of inoculation and application, may explain inconsistencies in conflicting testimonials, and the long-term or "reach back" potential of Phostrol™.

Table 2. Effect of post-inoculation interval on post-harvest treatment for incidence of late blight on Russet Burbank tubers.[1]

Treatment	Post inoculation interval (hours)									
(rate/ton tubers)	0		1		2		4		6	
Untreated control	80.0	a	73.3	a	76.7	a	93.3	a	80.0	a
HPPA (1:50 dilution)	10.0	b	33.3	b	40.0	b	63.3	b	71.7	a
Zoxamide (1.28 oz)	0.0	c	8.3	c	18.3	c	30.0	c	43.3	c
Phostrol™ (1:5 dilution)	0.0	c	0.0	c	1.7	d	0.0	d	6.7	d

[1]Values in the same column followed by the same letters are not significantly different at p=0.05.

LARGE SCALE STUDIES

Large scale studies of 2,000 lbs of potatoes for each disease were stored for 77 days at 48°F and showed similar results as the small scale studies (Table 3). There was a complete control of late blight and pink rot disease in tubers treated with 12.8 fl. oz/ton of Phostrol™. Even the lower rates of Phostrol™ were effective at suppressing disease development. There was no significant difference between the untreated control and an application of HPPA. In previous tests with washed tubers HPPA showed some reduction in tuber rot. However, the potatoes used in this study were treated directly out of the field and the presence of the soil on the tubers may have compromised the efficacy of the product.

Table 3. Effect of post harvest applications of phosphorous acid (Phostrol™) and hydrogen peroxide/peroxyacetic acid (HPPA; Oxidate™) on percent potato tuber rot after 77 days in storage.[1]

Treatment	Rate/ton tubers	*Late blight (%)*	*Pink rot (%)*
Untreated control		90 a	61 a
HPPA	1:25 dilution	84 a	73 a
Phostrol™	1.6 fl oz (1:40 dilution)	26 b	32 b
Phostrol™	3.2 fl oz (1:20 dilution)	14 bc	10 b
Phostrol™	12.8 fl oz (1:5 dilution)	0 c	0 c

[1] Tubers with typical disease symptoms or showing symptoms of secondary soft rot were counted as rotted tubers. Values in the same column followed by the same letters are not significantly different at p=0.05.

Label rates of Phostrol™ showed no significant impact on processing quality (Table 4). Fry color, as measured by reflectance, and sugar concentrations were similar between the control and Phostrol™ applied potatoes. These results indicate that Phostrol™ can be applied to processing potatoes with no concern of altering quality.

Table 4. Effect of Phostrol™ on tuber processing quality after 77 days in storage.[1]

Parameter	Untreated Control	Phostrol™ (12.8 fl. oz.)
Glucose (%fwt)	0.0486 a	0.0415 a
Sucrose (%fwt)	0.1028 a	0.1093 a
Mean fry color[2]	50.9 a	51.4 a

[1]Values in the same row followed by the same letter are not significantly different.
[2]USDA fry color rating #1≥ 44, #2 < 44 but ≥ 35, #3 = < 35 but ≥26 reflectance

SUMMARY

In general, there are post-harvest product options available that may be effective for your potato program, but they must be used in combination with good, basic storage management strategies. Phosphorous acid won't stop disease in tubers already infected in the field but post-harvest applications of phosphorous acids can be effective at minimizing the spread of pink rot and late blight during handling and in storage. The effectiveness of these products on other potato pathogens is still unknown, but it is currently being investigated.

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