Twelfth EuroBlight workshop
Arras (France), 3-6 May 2010

Post-Harvest Application of Phosphorous Acid for Control of *Phytophthora infestans* on Potatoes

STEVEN B. JOHNSON

University of Maine Cooperative Extension
P. O. Box 727, Presque Isle, Maine, USA, 04769

SUMMARY
Potato tuber rot from late blight causes economic loss and an effective post-harvest treatment to control this disease is needed. The purpose of this study was to further investigate the value of phosphorous acid at reduced application volumes in preventing tuber-to-tuber spread of *Phytophthora infestans* during the mechanical harvesting and tuber handling in a situation where the disease is present at harvest.

KEY WORDS:
Solanum tuberosum, late blight, potato storage

INTRODUCTION

Late blight, caused by *Phytophthora infestans* (Mont.) de Bary is a devastating potato tuber disease as well as foliar disease. Late blight regularly causes loss in many potato production systems (Stark and Love, 2003). Tuber loss owing to this pathogen with skinned or damaged tubers has long been established (Bonde and Schultz, 1949). Tuber-to-tuber spread is encouraged when tuber damage or skin damage occurs during the mechanical harvesting and tuber handling procedures (Lambert *et al.*, 1998). With late blight present in the field, storage losses can occur well beyond what would be expected based on the pathogen level in the field.

Phosphorous acid (phosphonate or phosphate) is the anionic metabolite of the systemic fungicide aluminum tris-O-ethyl phosphonate (fosetyl-Al) (Ouimette and Coffey, 1989). Phosphorous acid has systemic antifungal activity towards mycelial growth and is not a nutritional source (Fenn and Coffey, 1989). Phosphorous acid is effective in reducing oomycete-incited diseases (Forrester *et al.*, 1998). Reports on the effectiveness by phosphorous acid materials for late blight control have appeared. Most of the information is in-season applications and not post-harvest applications (Cooke and Little, 2001; Johnson *et al.*, 2004; Mayton and Fry, 2006). Phosphorous acid materials are now labeled for post-harvest use on potatoes (Johnson, 2007). Johnson (2007, 2008) previously discussed effectiveness of the applications with respect to the timing of applications following mechanical damage.

PPO-Special Report no. 14 (2010), 85 - 88

The purpose of this study was to investigate the value of phosphorous acid at reduced application volumes in preventing tuber-to-tuber spread of *P. infestans* during the mechanical harvesting and tuber handling in a situation where the disease is present at harvest.

MATERIALS AND METHODS

In 2010, potato tubers (cv. Katahdin) were selected to insure there was no existing late blight. The tubers were individually abraded. Abrasion was accomplished by holding a tuber against a belt sander operating at moderate speed. The abraded area encircled each tuber. The abrading completely removed the skin and exposed the tuber periderm. This mimicked skinning damage as well as more severe tuber damage. The abrading simulated damage which may occur during mechanical harvesting and tuber handling procedures and to facilitate transfer of pathogen from infected tubers to healthy tubers. The abrasion also provided ideal an infection site for the *P. infestans*.

Immediately following abrading, the tubers were dampened to improve infection conditions and then inoculated with *P. infestans* (US-8 genotype). Pathogen isolates were isolated from locally infected tubers onto water agar and then transferred to V-8 agar. Cultures of the pathogen were macerated to prepare inoculum. A titer of approximately 50,000 propagules per ml was used to inoculate the abraded tubers. Propagules consisted of both sporangia and mycelial fragments. Each abraded test tuber was atomized with approximately 1 ml of the pathogen solution.

Treatments consisted of phosphorous acid (Phostrol) at the rate of 378 ml per 907 kg of tubers applied at a volume of 1900 ml, 950 ml, and 475 ml per 907 kg, and an untreated control. The full rate of Phostrol was applied in full, half and quarter labeled application volumes to simulate coverage variability with reduced spray volumes. All treatments were applied 1 hour post inoculation. Treatment timing of 1 hour post inoculation was chosen as the potential waiting period between harvest and unloading in a commercial situation. In each case, experimental units consisting of 9.1 kg of abraded and inoculated tubers were arranged in a randomized complete block design, placed into a controlled atmosphere storage, and held at 13°C with a relative humidity greater than 95%.

The experimental units were removed and tubers individually peeled and evaluated for disease symptoms after three weeks of storage. Tubers were rated as either infected or not infected. Data were recorded on a percentage basis and analyzed untransformed with Fisher's LSD test. Data and analysis appear in table 1.

RESULTS AND DISCUSSION

With the high pathogen titer and warm storage conditions used in this study, presence or absence of rot was an effective disease rating. Tubers were either heavily diseased or not at all. Previously reported efforts document phosphorous acid materials provide complete control tuber-to-tuber late blight spread (Johnson 2007, 2008). However, less than complete control of *P. infestans* occurred at less than labeled rates. One quarter rate of phosphorous acid failed to provide complete control of tuber-to-tuber late blight spread. Uncertain was whether this result was a result of material effectiveness with reduced rates, inadequate coverage, or a combination of both.

This test was designed to simulate tuber-to-tuber late blight spread. The high inoculum titer and severe tuber damage under favorable conditions produced all diseased tubers or no diseased tubers with proper phosphorous application. Complete control under these conditions is significant and it can be postulated that other phosphorous acid materials would provide similar control.

Results from this study also show a less than complete control at a full rate of phosphorous acid applied at one quarter rate of the recommended application volume (table 1). Applications with less than half the recommended material or less than half the recommended application volume failed to provide complete control of tuber-to-tuber late blight spread. Concerns with reduced application volumes are as valid as previous concerns with reduced rates. Since most growers have a zero tolerance for late blight in storage, application volumes or phosphorous acid rates less than half should be avoided.

Table 1. *Severity of late blight on Katahdin potatoes after three weeks of storage with varied application volumes with Phostrol.*

Treatment	Application volume*	Late Blight (%)
Check	0	100.0
Phostrol**	475 ml	23.5
Phostrol**	950 ml	0.0
Phostrol**	1900 ml	0.0
LSD value at alpha = 0.05		6.1

** per 907 kg tubers, ** applied at the rate of 378 ml per 907 kg tubers*

REFERENCES

Bonde, R. and E.S. Schultz. 1949. Control of Late-Blight Tuber Rot. Maine Agricultural Experiment Station Bulletin #471, pp: 16.

Cooke, L. R. and G Little, 2001. The effect of foliar application of phosphonate formulations on the susceptibility of potato tubers to late blight. Pest Management Science 58:17-25.

Fenn, M. E... and M. D. Coffey, 1989. Quantification of phosphonate and ethyl phosphonate in tobacco and tomato tissues and significance for the mode of action of two phosphonate fungicides. Phytopathology 79:76-82.

Forster, H., J. E. Adaskaveg, D. H. Kim and M. E. Stanghellini, 1998. Effect of phosphite on tomato and pepper plants and on susceptibility of pepper to Phytophthora root and crown rot in hydroponic culture. Plant Dis. 82:1165-1170.

Johnson, D. A., D. A. Inglis and J. S. Miller, 2004. Control of potato tuber rots caused by oomycetes with foliar applications of phosphorous acid. Plant Dis. 88:1153-1159.

Johnson, S. B. 2007. Post Harvest Application of Phosphorous Acid Materials to Reduce Potato Storage Rots. Phytopathology 97(7): S178-179. Abstr. (Supplement)

Johnson, S. B. 2008. Post-Harvest Applications of Phosphorous Acid Materials for Control of *Phytophthora infestans* and *Phytophthora erythroseptica* on Potatoes. Plant Pathology Journal 7(1):50-53.

Lambert, D. H., A. I. Currier and M. O. Olanya, 1998. Transmission of *Phytophthora infestans* in cut potato seed. Amer. J. Potato Res. 75: 257-263.

Mayton, H and W.E. Fry, 2006. Evaluation of phosphonate fungicides for control of foliar and tuber late blight of potato. Phytopathology 96:S186 (abstr.).

Ouimette, D. G. and M. D. Coffey, 1989. Phosphonate levels in avocado (*Persea americana*) seedlings and soil following treatment with fosetyl-Al or potassium phosphonate. Plant Dis. 73:212-215.

Stark, J. C. and S. L. Love, 2003. Potato Production Systems. University of Idaho Agriculture Communications, Moscow, Idaho, 426 pp.