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Control of *Phytophthora infestans* (the Cause of Late Blight of Potatoes) *in vitro* Using OxiDate™

Khalil I. Al-Mughrabi
Potato Development Centre, Department of Agriculture,
Fisheries and Aquaculture, 39 Barker Lane, Wicklow, New Brunswick, Canada, E7L 3S4

Abstract: A laboratory trial was conducted to test the efficacy of OxiDate™ in controlling the late blight of potato and tomato fungus, *Phytophthora infestans*. In addition to the control, three OxiDate concentrations (1:150, 1:100 and 1:50 of OxiDate to water) were used in this study. A total of 17 different late blight isolates collected from New Brunswick, Prince Edward Island, Manitoba and Quebec (Canada) were subjected to various concentrations of OxiDate in a replicated experiment using a 2-way Completely Randomized Design. Growth of all isolates was inhibited when the 1:50 OxiDate concentration was used. At the 1:100 concentration, growth of 94.1% of the late blight isolates used was completely inhibited. At the lowest concentration of 1:150 OxiDate, the growth of 76.5% of the isolates tested was completely inhibited. The results of this study suggest that OxiDate has the potential to be used in preventing the occurrence of late blight in potato tubers if applied on potatoes in the proper manner after harvest and prior to storage.

Key words: Hydrogen peroxide, *Solanum tuberosum*

INTRODUCTION

Phytophthora infestans (Mont.) deBary, the cause of late blight of potato, is a devastating disease of potato foliage and tubers worldwide. Infection can reduce both crop quantity and quality. Additional costs are incurred when money is spent on management practices to suppress the disease. The introduction of new genotypes of *P. infestans* in to the United States and Canada during the late 1980s and 1990s has coincided with an increase in the incidence and severity of late blight[1,2]. Many of the new genotypes are of the US-8 (A2) mating type and insensitive to the fungicide metalaxyl[3]. Recent studies[4-11] have shown that US-8 isolates are more aggressive on potato foliage and tubers than US-1 isolates. In Canada, the US-8 genotype has displaced US-1 in most potato production areas outside British Columbia[12]. Tubers generally are infected by inoculum produced in aboveground plant parts. The inoculum is subsequently washed down to the soil by precipitation events[13-15]. Because soilborne oospores of *P. infestans* are rare in most potato production systems in the United States and Canada, infection of potato tubers in the field is initiated most commonly by inoculum, i.e., sporangia and zoospores, produced on the plant foliage. Thus, developing tubers can become blighted shortly after late blight is established on potato foliage[16]. Once the inoculum produced on the foliage is deposited onto the surface of the potato hill, water from irrigation or rain can carry it into the soil[17-20]. Under high humidity (80-100%) and warm temperatures (15-20°C), the late blight fungus present on the surface of tubers can germinate and start new infection[5]. Applying disinfectants may help reduce or eliminate the source of inoculum on the tubers prior to storage and consequently protect the tubers from infection. No research has been published on the effect of OxiDate against late blight of potatoes. The purpose of this *in vitro* study was to explore the ability of OxiDate (hydrogen peroxide) to prevent or retard the growth of *P. infestans*.

MATERIALS AND METHODS

A total of seventeen isolates from New Brunswick, Prince Edward Island, Manitoba and Quebec were used in this study. Some of these isolates belong to the more aggressive strain US8 (A2) of late blight (Table 1). Others belong to the less aggressive strain US1 (A1) strain.

Fungal isolates of late blight of potatoes were maintained on Rye Extract Agar (REA) medium and the cultures were stored at room temperature. The medium (10 mL) was dispensed in sterile Petri plates and allowed to cool down before use. The isolates were allowed to grow for 7-10 days before they were used in this study.

Methods of Al-Mughrabi *et al.*[21] were followed. OxiDate was diluted with Sterile Distilled Water (SDW) to give a final concentration of 1:50, 1:100 and 1:150. A treatment containing SDW was used as an untreated

Table 1: *Phytophthora infestans* isolates used in the *in vitro* OxiDate study

Isolate	Source	Strain
01NB	New Brunswick	US8 (A2)
02NB	New Brunswick	US1 (A1)
03NB	New Brunswick	N/A*
01PEI	Prince Edward Island	N/A
02PEI	Prince Edward Island	N/A
03PEI	Prince Edward Island	N/A
04PEI	Prince Edward Island	US8 (A2)
05PEI	Prince Edward Island	US8 (A2)
06PEI	Prince Edward Island	US1 (A1)
02MB	Manitoba	N/A
03MB	Manitoba	N/A
04MB	Manitoba	N/A
05MB	Manitoba	N/A
06MB	Manitoba	N/A
07MB	Manitoba	N/A
08MB	Manitoba	N/A
03QC	Quebec	N/A

* Not identified.

check. The solution of each treatment was evenly distributed on REA in the designated petri plates. Each plate received 2 mL of the designated OxiDate solution. Control plates received 2 mL of SDW each. Plates were left for 2 h in a sterile hood at room temperature before inoculation with *Phytophthora infestans* in order for the solutions to be absorbed through the media.

With a 10 cm long spring-loaded plunger of 5 mm diameter, a plug of inoculum from the actively growing margin of a petri plate culture of *P. infestans* was placed in the center of each petri plate with the mycelium face down. Each isolate for each solution was inoculated onto four plates and was allowed to incubate for 8 days at room temperature (~ 22°C). Four control plates receiving SDW only were run along each fungal isolate and OxiDate solution. The experiment was repeated.

The radial growth (average of 2 readings: vertical and horizontal) was measured for each plate 8 days after inoculation[21]. Data were analyzed using CoStat Statistical Software based on a 2-way Completely Randomized Design.

RESULTS AND DISCUSSION

Significant differences between OxiDate treatments in their effect on controlling the late blight fungus *P. infestans* were observed (Table 2). Results of mean separation (Fig. 1), using Student-Newman-Keuls test, showed that all OxiDate treatments were significantly different compared to the untreated control ($LSD_{0.05}$ = 1.1506). All OxiDate treatments were effective against late blight isolates, including the most aggressive strain US8. Average colony growth for all isolates in the control plates was 46.26 mm, compared to 3.64, 2.90 and 0.00 mm at 1:150 (0.0067% OxiDate), 1:100 (0.01% OxiDate) and 1:50 (0.01% OxiDate), respectively.

Table 2: ANOVA table for OxiDate treatments and *Phytophthora infestans* isolates used in an *in vitro* study

Source	DF	MS	F	p[1]
Treatment (T)	3	2867.5	0.000	***
Isolate (I)	16	90.7	0.000	***
Interaction (T x I)	48	25.4	0.000	***
Model	67	168.3	0.000	***
Error	204			
Total	271			

[1]Significant at 5%.

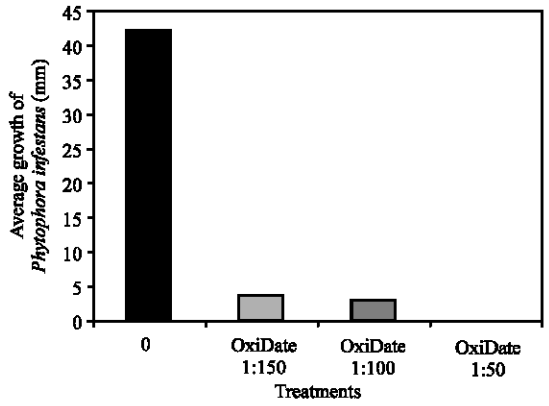

Fig. 1: Average growth of all *Phytophthora infestans* isolates grown on Rye Extract Agar (REA) plates amended with various concentrations of OxiDate

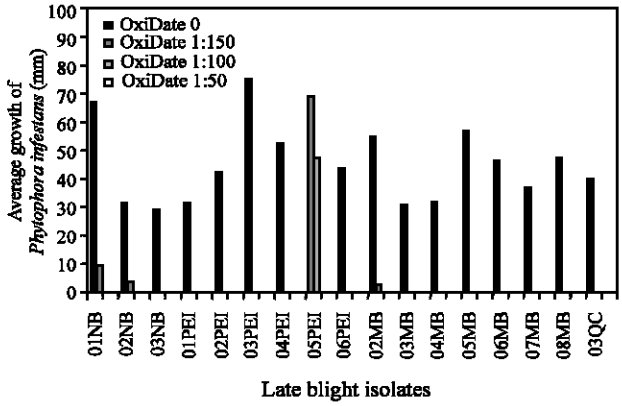

Fig. 2: Average growth of 17 isolates of *Phytophthora infestans* on REA amended with various concentrations of OxiDate

None of the 17 *Phytophthora infestans* isolates grew on the 1:50 OxiDate concentration. Only one isolate (05PEI) grew on the 1:100 concentration and 4 isolates (01NB, 02NB, 05PEI and 02MB) grew on the 1:150 concentration (Fig. 2).

Based on these results, it is concluded that OxiDate is very effective in controlling late blight *in vitro*. Both 1:100 and 1:50 concentrations gave excellent inhibitory effect of *P. infestans*. The 1:150 concentration was effective, however, some isolates of the US8 (A2 - most

aggressive strain) and US1 (A1-less aggressive strain) were not completely inhibited by OxiDate at this lower concentration.

It is recommended that either 1:50 or 1:100 OxiDate to water concentrations be used to protect potato tubers from infection with late blight. Application of OxiDate should be done immediately after harvest and before storing potatoes. The initial application at the conveyer belt might be useful to protect any late blight spores present on the surface of the tuber from surviving and penetrating through wounds or natural orifices. More research (greenhouse, growth chamber, etc.) is recommended to test the effect of OxiDate on potato tubers by applying OxiDate and then infecting with *P. infestans*.

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