

## **Information regarding Peroxyacetic Acid and its efficacy to treat Citrus Canker bacteria *Xanthomonas axonopodis* pv. *citri***

USDA PPQ Treatment Quality Assurance Unit evaluated the data provided from third-party laboratories on the efficacy of peroxyacetic acid (peracetic acid) products and determined that this bactericide provides treatment at 85 ppm for a 1 minute exposure which is at least as efficacious for *Xanthomonas axonopodis* pv. *citri* as the currently approved bactericides listed in the regulations.

The current maximum EPA accepted label rate for peroxyacetic acid (peracetic acid or PAA) products when applied to raw unprocessed fruit surfaces is 85 ppm.

PAA products are equilibrium mixtures of peroxyacetic acid, hydrogen peroxide, acetic acid, and water. Peracetic acid is produced by a reaction between hydrogen peroxide and acetic acid. When peracetic acid dissolves in water, it disintegrates to hydrogen peroxide and acetic acid, which will break down to water, oxygen and carbon dioxide. Peracetic acid degradation products are non-toxic and easily dissolve in water.

### Test Result Summaries

The Florida Department of Agriculture and Consumer Services requires citrus canker disinfestation products to pass a use dilution test with an organic matter and hard water challenge (simulating actual field conditions), and a time kill study (to determine how quickly the products kill citrus canker bacteria). For any product submitted for use in Florida for treatment, the company supplying the products must provide a method (commercial test kit) for monitoring the level of the product.

In several of the studies, *X. axonopodis* pv. *citrumelo* cultures were utilized in testing of the peroxyacetic acid (PAA) products rather than the citrus canker bacteria, *X. axonopodis* pv. *citri*. *X. axonopodis* pv. *citrumelo* is considered to be a suitable surrogate.

Experiments were conducted by third party laboratories in conformance with AOAC Method 960.09 for Germicidal and Detergent Sanitizing Action of Disinfectants and ASTM Standard Test Method (E 1153-94) for Efficacy of Sanitizers Recommended for Inanimate Non-Food Contact Surfaces and fulfills EPA requirements. All tests were conducted on bacteria cultures in test tubes under laboratory conditions, except for one.

At a 1:100 product dilution (2700 ppm PAA), bacteria cultures were tested at exposures of 30 seconds, 1 minute, and 3 minutes. The test resulted in a 99.99% population reduction of a known concentration of *X. a. pv citri* at all time intervals.

At product dilution rates of 1:300 (900 ppm PAA) and 1:600 (450 ppm PAA) with 2, 5, and 10 minute exposure times, the test resulted in a 99.99% population reduction of a known concentration of *X. a. pv citri* for both dilutions and at all time intervals.

For a product test of 149 ppm PAA, at an exposure of 10 minutes, the test resulted in a 99.99% population reduction of a known concentration of *X. a. pv. citri*.

At product rates of 85 ppm and 200 ppm PAA, with exposure times of 30 seconds and 1 minute, the tests met the standard efficacy (99.999% reduction of a known concentration of *X. a. pv. citrumelo*) at all tested concentrations.

At product rates of 5 ppm, 10 ppm, 20 ppm, 40 ppm, 50 ppm, 60 ppm, 70 ppm, and 80 ppm PAA, with a 1 minute exposure the test resulted in determining a effective product level of more than 10 ppm but less than 20 ppm PAA for a 99.99% population reduction of a known concentration of *X. a. pv. citrumelo*.

One test was conducted directly on citrus fruit surfaces for reduction of *Salmonella sp.* on the surface of the fruit. In general, *Salmonella* is more resistant to sanitization by peracetic acid than *Xanthomonas*. The test was conducted in response to multiple outbreaks of *Salmonella* in 1999 is association with the fresh squeezed orange juice industry. Test concentrations of 0, 50 and 85 ppm PAA were used with a 1 minute dip exposure on Hamlin oranges which had been surface inoculated with a known concentration of *Salmonella sp.* The 85 ppm level of PAA provided a 99.999% reduction of *Salmonella* on the fruit surface. The addition of a food grade surfactant provided a one step reduction to comply with FDA's requirement of reduction of relevant pathogens on the surface of fruit meant for fresh juice extraction.

In the opinion of researchers in Florida working with the citrus industry, PAA is believed to be better than chlorine and hydrogen peroxide for disinfecting fruit in addition to reducing fruit blemishes caused by treatment and maintaining fruit quality as compared to other products.

Peracetic acid is listed under: 7 CFR Sec. 205.601 Synthetic substances allowed for use in organic crop production.

In Australia, peracetic acid has been approved for postharvest decontamination of citrus fruit surfaces in association with Citrus Canker, and is utilized in the organic citrus packing industry for disinfestation of fruit.

### **Use of Peroxyacetic acid (PAA) products for disinfecting equipment**

The 1 minute time interval was shown to be effective by third party labs submitting data in support of the efficacy of PAA for *Xanthomonas axonopodis pv. citri*, along with 1 minute being a standard dwell time of the equipment used in the packinghouse line. Data also supporting a shorter time interval for disinfecting, so 1 minute should be adequate without being marginal in time of exposure. Wetting to the point of runoff would be used for surfaces that would be composed of nonhost material but could possibly be exposed to the citrus canker bacterium during washing and movement of fruit.

Studies on efficacy of PAA products were conducted according to:

1. *AOAC Method 960.09 for Germicidal and Detergent Sanitizing Action of Disinfectants*  
Suitable for determining minimum concentration of chemical that can be permitted for use in sanitizing precleaned, nonporous food contact surfaces.

2. *ASTM Standard Test Method (E 1153-94) for Efficacy of Sanitizers Recommended for Inanimate Non-Food Contact Surfaces*

This test method is used to evaluate the antimicrobial efficacy of sanitizers on precleaned inanimate, nonporous, non-food contact surfaces.

This test method may also be used to evaluate the antimicrobial efficacy of one-step cleaner/sanitizer formulations recommended for use on lightly soiled, inanimate, nonporous, non-food contact surfaces.

Peroxyacetic acid is labeled for use on surfaces to control the spread of citrus canker at the rate of 85 ppm and a minimum surface contact of 1 minute. Personnel involved with the industry in Florida commented that it will be difficult to apply PAA products to packinghouse equipment to the point of run-off in less than 1 minute based on their experience. The products are not rinsed off and are allowed to air dry after application. Surfaces include walls, floors, conveyors, and harvesting containers.

Peroxyacetic acid is used mainly in the food industry, where it is applied as a cleanser and as a disinfectant.

Peroxyacetic acid is applied for the disinfection of medical supplies and to prevent biofilm formation in pulp industries.

PAA products are labeled for sanitizing non-porous food contact surfaces, eating establishment sanitizing, and sanitizing tableware at a rate of 87.7 to 149 ppm.

PAA is also labeled for:

Sanitization of conveyors, peelers, slicers, and saws for meat, poultry, seafood, fruits, and vegetables.

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