A FLOOD-RECOVERY TBZ FUNGICIDE TREATMENT SYSTEM FOR CITRUS FRUITS

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Abstract. **A commercial flood-recovery method for thiabendazole (TBZ) application with electronic monitoring and control was observed in a citrus packinghouse for 2 seasons. TBZ suspension values ranged from ca. 100 to 3000 ppm the first season and ca. 250 to 1800 ppm the second season. Fruit TBZ residues were mostly between 0.4 and 1.5 ppm, higher than those expected from non-recovery sprays or water wax suspension applications. Positive correlations were found for TBZ fruit residues vs. both the concn and the pH of treatment suspensions, but not for suspension concn vs. pH. Two holding tests indicated about 50% decay control.**

State regulations (1) require that Florida fresh citrus fruits must be treated with a post-harvest fungicide to minimize the consumers' risk of losing fruit by decay prior to consumption. One of the fungicides recommended for such use is thiabendazole (TBZ) (4). Current recommendations are based on many years of testing (3, 5) and include specific recommendations for application methods which exclude a flood-recovery system "because there is no rapid method of determining the strength of the TBZ suspension" (4). However, in terms of decay control, one of the better methods of TBZ application is reported to be the flood-recovery system (5).

A commercial flood-recovery TBZ application system[1] used in one Indian River and one Interior District packinghouse provided fruit residues adequate for the state regulations (1) and decay control apparently satisfactory to the packinghouse managers. This study was initiated to determine the consistency and effectiveness of this system.

Materials and Methods

Thirteen fruit and 5 TBZ suspension samples were collected and analyzed at the Florida Division of Fruit and Vegetable Inspection Labs during the 1972-73 season. In the 1973-74 season, paired fruit and TBZ suspension samples were collected to evaluate the monitoring ability of the system. Residue determinations were made with a colorimetric procedure reported in 1971 (2) using blended whole fruit the first season and TBZ extracted from the fruit surface the second season. All samples for this report were collected from the large line of Winter Haven Citrus Growers Association. Fruit samples were analyzed for TBZ residues, while suspension samples were evaluated for pH and TBZ concn.

The system (Fig. 1) includes a source tank containing a TBZ 3% concn, a flood-recovery tank and flood trough, a control box with the reputed ability to sense the concn of TBZ by measuring electrical conductivity, and pumps to circulate the TBZ suspension as a flood over the fruit and to replenish TBZ from the source tank as needed.

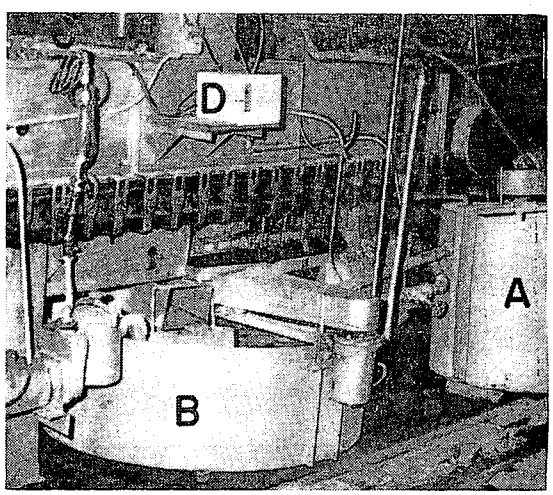

Fig. 1. TBZ flood-recovery applicator including: (A) source tank, (B) flood-recovery tank, (C) flood trough, (D) control box and pumps to maintain the level and concn of TBZ suspension.

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[1]Product of Food Chemical Research Inc., Vero Beach, Florida.

Each tank incorporates mechanical agitation to aid in maintaining the suspensions. Water is added as needed to the recovery tank to replace that carried away by the fruit (simple float valve detector) and to dilute the TBZ added from the source tank (control box detector).

In the second season, samples of untreated and TBZ treated fruit were collected twice for decay control evaluations. In each case three replications of one carton each were held for 2 weeks at 21°C (70°F).

Results

During the first season, fruit residues varied from 0.50 to 1.82 ppm[2]. TBZ suspension samples collected independently of fruit samples decreased from 2400 ppm to 970 ppm as the company made adjustments to reduce the level to 1000 ppm.

During the second season, TBZ fruit residues, ranging from 0.31 to 1.34 ppm, had a significant correlation with TBZ concn of corresponding treatment suspensions which varied from 262 to 1785 ppm (Fig. 2). Fruit residues also had a positive correlation with pH 7.9 to 10.8 of the treatment suspension (Fig. 3). However, no correlation was found between concn and pH of the treatment suspension.

TBZ residues in fruit held for decay control evaluations (Fig. 4) were 1.26 ppm for 'Orlando' tangelos and 0.54 ppm for 'Temples'. In each case, treated fruit developed about half the amount of decay as the untreated check fruit held for 2 weeks at 21°C. 'Orlandos' sampled December 18 were very mature and thus were very subject to decay.

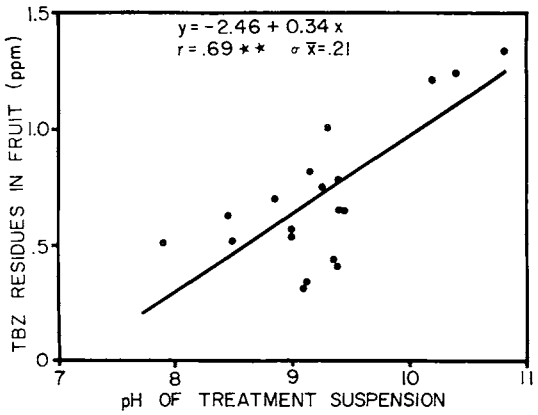

Fig. 3. TBZ citrus fruit residues as related to pH of treatment suspension for a flood-recovery application system sampled during the 1973-74 season.

Discussion and Conclusions

TBZ residues in fruit treated with the flood-recovery system were higher than would be expected with the aqueous spray or water wax application systems currently recommended and in common use (4). Higher TBZ residue levels than the minimum 0.1 ppm required (1) for Florida citrus are not believed to necessarily result in better decay control. Decay control was comparable

[2]State regulations stipulate a minimum TBZ residue of 0.1 ppm. Federal law sets a maximum of 2.0 ppm.

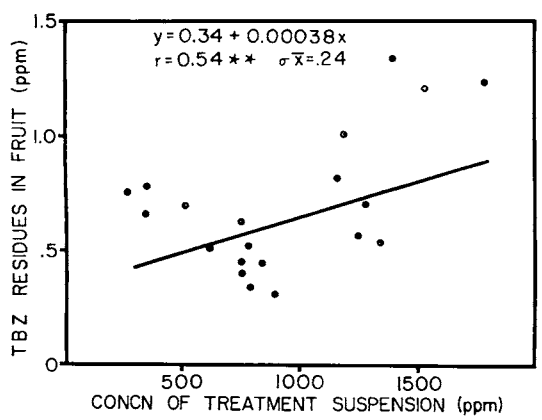

Fig. 2. TBZ citrus fruit residues as related to concn of treatment suspension for a flood-recovery application system sampled during the 1973-74 season.

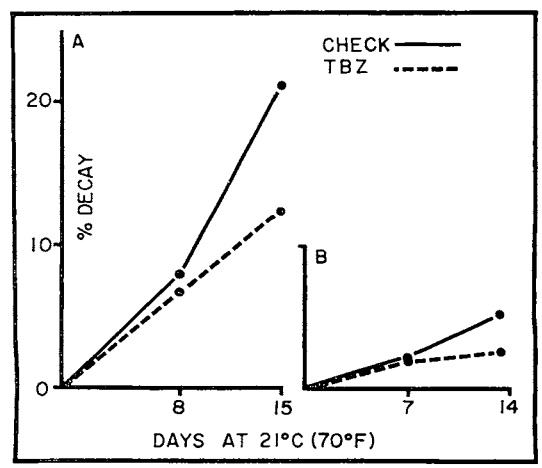

Fig. 4. Citrus fruit without and with TBZ flood application. A. 'Orlando' tangelos sampled Dec. 18, 1973. B. 'Temples' sampled Jan. 21, 1974.

to that commonly observed with other TBZ treatments on similar fruit.

The fact that TBZ residues are positively correlated with suspension concn for this system is encouraging in that it indicates the possibility of reducing the amount of fungicide used while controlling residue levels within legal limits. Control of the TBZ concn as sampled for two seasons needs to be refined and improved. Broken or injured citrus fruits gradually acidify the suspension pH in a flood-recovery application system. It would be better to redesign the control device and reformulate the TBZ to avoid dependency upon pH to more accurately control TBZ concn in this flood-recovery system.

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REDUCING SODIUM O-PHENYLPHENATE LEVEL IN SIMULATED PACKINGHOUSE EFFLUENT WITH ACTIVATED CARBON

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Abstract. **The fungicide sodium o-phenylphenate (SOPP), used on citrus fruit and other horticultural crops to control decay, is a major phenolic contaminant in citrus packinghouse effluent. In laboratory tests, activated carbon removed SOPP efficiently. An attempt was made to remove SOPP from large volumes of simulated packinghouse effluent. 1100 gal (4163.5 liters) of 100 ppm SOPP was pumped through a filtration-purification system packed with 3 lb. (1362 g) granular activated carbon. Removal efficiency gradually declined as greater volume of SOPP solution was passed through the unit. Overall removal efficiency attained was 51%. Commercial filtration-purification systems are available for large scale treatment of effluent.**

Last year we reported on sources and levels of phenolic contaminants in citrus packinghouse effluents and their potable water supplies (3). The fungicide sodium o-phenylphenate (SOPP), commonly known as Dowicide A[1], was shown to greatly contribute to phenolic levels in effluents from citrus packinghouses.

Search for methods of removal was initiated. Polyclar AT, an insoluble form of polyvinylpyrrolidone, removed 92 to 95% SOPP from 100 ppm SOPP when used at 10 g/100 ml soln. Powdered activated carbon, however, proved more effective; it removed 99.6% SOPP from 100 ppm soln when used at 0.25 g/100 ml. Activated carbon has also been used in treatment of raw sewage reducing chemical oxygen demand (COD) by 500 to 550 mg/g carbon (1).

This paper presents results of a test on a larger scale on the efficiency of granular activated carbon in removing SOPP from simulated packinghouse effluents.

Materials and Methods

Aqueous solns of ca. 100 ppm SOPP (0.3785 g/gal) ranging in vol between 15 and 150 gal were

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