

Pome Fruit Treatment Guide

MERTECT[®]
340-F

**Mertect 340-F Fungicide
for Postharvest Treatment
of Pome Fruit**

syngenta



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Introduction

Mertect® 340-F fungicide is registered for postharvest use on apples and pears for control of blue mold, bull's-eye rot, and gray mold (nest rot, cluster rot), and stem end and neck rot. Mertect may be applied as a dip, flood or spray to harvested fruit. Use a suspension of 16 fl. oz. of Mertect in 100 gallons of water. DO NOT treat fruit for longer than 3 minutes. Treat apples once before storage and once after storage for maximum decay control. Treat pears only once.

COMPATIBILITIES WITH OTHER POSTHARVEST TREATMENT MATERIALS

Laboratory results indicate that Mertect is physically and biologically compatible with diphenylamine (DPA) and ethoxyquin (excluding Stop Scald®). The label for Mertect does not prohibit tank mixes or combinations with other products.

DRENCH TANK CONCENTRATION AND FRUIT RESIDUE ANALYSIS

Assay procedures are available that provide a simple and efficient method for determining the concentration of Mertect in drench tank solutions or the amount of residue on treated fruit. Special procedures must be followed when making these determinations if diphenylamine (DPA), captan or ethoxyquin are used in combination with Mertect. Refer to the technical information on page eight of this brochure, entitled “*Analysis Guide for Use on Pome Fruit: Drench Bath Assay*” for specific details. For additional information, visit www.postharvestuniversity.com or call the Syngenta Customer Resource Center at 1-866-SYNGENTA.

READ AND FOLLOW THE DIRECTIONS FOR USE AND PRECAUTIONARY STATEMENTS ON ALL PRODUCT LABELS INTENDED FOR USE IN POSTHARVEST FRUIT TREATMENT(S)

The directions for use of this product are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this and other products. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as fruit quality, weather conditions, the presence of other non-labeled diseases, or the manner of use or application, all of which are beyond the control of Syngenta or the seller. Treatment may not be effective if tolerant strains of fungi develop. Use of alternate fungicides or treatment methods should be considered if treatment with Mertect proves ineffective. All such risks shall be assumed by the buyer. In no case shall Syngenta or the seller be liable for consequential, special or indirect damages resulting from the use of combinations of Mertect and materials used for “scald control.”

Initial Charge and Maintenance Recharge Guide for Apple and Pear Drenches

INITIAL CHARGE:

Use 16 fl. oz. of Mertect per 100 gallons of water. DO NOT treat fruit for longer than 3 minutes. Apples may be treated twice; once before storage and once after storage for maximum decay control. Treat pears only once.

RECHARGE DATA TO MAINTAIN CONCENTRATION:

Tank Size (gal.)	Recharge After Treating (bins)	Recharge Rate* (fl. oz.)
100	30	3
200	60	5
300	90	7
400	120	10
500	150	12
600	180	15
700	210	17
800	240	19
900	270	22
1000	300	24

**Based on 15% of the initial charge of Mertect 340-F rounded off to the nearest ounce.*

EXAMPLE:

The initial charge in a 500 gallon tank would require 80 fl. oz. of Mertect. Therefore, $80 \times 15\% = 12$ fl. oz. required to recharge the tank to the approximate initial level.

NOTE:

If water is added, then additional Mertect should be added at the rate of 16 fl. oz./100 gallons of water.

Factors such as dirt, fruit temperature and varieties may deplete tank concentrations more rapidly than indicated by the recharge chart above. An ultraviolet spectrophotometer may be used to provide analytical support in determining drench tank concentrations (in parts per million) and resulting fruit residues.

DISPOSAL:

Spent solutions generated by the use of this product may be disposed of in accordance with federal, state and local governmental regulations. For more information visit www.postharvestuniversity.com or call the Syngenta Customer Resource Center at 1-866-SYNGENTA.

Mertect Testing Supplies

The following items will be needed to set up a Mertect testing station for pome fruit drench bath testing:

Item(s)	Package Size	VWR Order Number	Approx. Cost (\$)	Number Needed	Notes
UV302 Spectrophotometer		Source: Astron Technologies, Raleigh, NC	1800.00	1	Six-week lead time for manufacturing.
600 ml glass beakers	1	13910-245	9.00	2	
Optical tissue - LENSX*90	1 pack	21912-158	27.00	1	
Stir bar retriever	1	F37772-0000	8.00	1	
Falcon® test tubes	25	20171-04	10.00	1	
Stir plate	1	33920-228	185.00	1	
Package of Pasteur pipettes	250		39.00	1 pkg.	
Pipette bulbs	12	56311-049	7.55	1 pkg.	
60 mm poly funnels	1		1.20	2	
Magnetic spin bar	1	Several	3.50	1	
Fisher cuvettes – for UV302	1	14 385 910C	90.00	2	EXTREMELY fragile and expensive. Source from Fisher Scientific.
Whatman #1 filter paper, 12.5 cm	100	28450-128	8.00	2 boxes	
0.1 N hydrochloric acid	10 liters	RC360025	70.00	2 pkg.	You will need 600 ml per sample – approx. 18 samples per 10 pkg.
Ethyl acetate	500 ml	EM-EX0240	12.00	1	1 bottle = approx. 50 samples.
Poly syringes – 5 cc and 25 cc	1			1 each	
Tea strainer		Provide locally	?	1	
Distilled water		Provide locally	?	2 gal.	
Paper toweling		Provide locally	?	??	For cleanup
		Total Approx. Cost	2468.45		

UVSpec 302 Absorption Spectrophotometer

Manufactured by Astron Technologies, Inc., the UVSpec302 measures the concentration, in parts per million (ppm), of thiabendazole in a sample from drench tanks or fruit. Measurements use the absorption of 302-nanometer ultraviolet light.

Calibration controls provide ZERO adjustment of the instrument with a 0-ppm sample and a SCALE adjustment with a calibration sample, such as 8 ppm.

The sample is placed in a $1/2'' \times 1/2'' \times 1^{3/4}''$ quartz cuvette and inserted into the sample holder of the UVSpec302 for measurement.

The UVSpec302 is designed to operate from 100 to 250 volts AC, 50 or 80 Hz, using the external power supply included with the instrument. The light source within the unit emits a narrow band of ultraviolet light in the range required for detection of thiabendazole.

For optimum stability, the photometer should be turned on at least 30 minutes before use. The sample-compartment plug, attached to the power-supply cable, should be inserted in the sample compartment to prevent contamination when cuvettes are not being placed in the compartment for ppm readings.

CAUTION. Before inserting any cell into the sample holder, the cell should be:

1. Wiped dry with a tissue, then wiped clean with lens tissue. The optical surfaces should be free of any optical interferences (liquid, fingerprints or dirt).
2. Covered to prevent spilling acid in the sample compartment. Any spills should be wiped dry IMMEDIATELY.
 - A. Fill a clean cuvette three-quarters full with 0.1 N HCl. Thoroughly dry and clean the outside of the cuvette. Cover the cell and place in the sample holder.
 - B. Adjust the ZERO potentiometer to obtain a scale reading of 0.00 ± 0.01 .
(For measurements below 1.50, it is advisable to recheck zero setting periodically.)
 - C. Replace the cuvette containing 0.1 N HCl (zero sample) with a cuvette containing a mid-range thiabendazole calibration standard, i.e., 8 or 10 ppm. Using the SCALE potentiometer, adjust the digital readout to read the same as the calibration standard. Replacing the calibration standard, i.e., 2, 4, 8, should produce readouts within ± 0.05 of the standard being read.
 - D. The UVSpec302 SCALE calibration should be made with a calibration standard at or higher than the largest ppm that is expected to be measured.
 - E. TO MEASURE THE ABSORBANCE OF A SAMPLE ASSAY, transfer a portion of the sample filtrate to a clean cuvette. Read the absorbance on the UVSpec302. In the equation for calibrating the absorbance of the washed fruit sample this value is called AFS.

CAUTION. TO PREVENT SAMPLE-TO-SAMPLE contamination, the cuvette should be drained on absorbent paper; rinsed 3 times with 2 ml portions of the fresh (or next) sample to be read.

Analysis Guide for Use on Pome Fruit:

DRENCH BATH ASSAY

I. INTRODUCTION

This assay is designed to determine the concentration of thiabendazole in drench bath solutions. With minor modifications to the basic procedure, the assay can be used when other chemicals such as captan, diphenylamine (DPA) or ethoxyquin are present in the drench bath.

The assay procedure has a high degree of accuracy, is simple, and requires very little time to run. The concentration of drench baths is derived from the use of a PHOTOM MODEL 302 spectrophotometer.

II. SOLUTIONS USED IN DRENCH BATH ASSAYS

- A. HYDROCHLORIC ACID 0.1 N. Dilute 25 milliliters (ml) of reagent grade (12N) hydrochloric acid to 3 liters of de-ionized water.
- B. ETHYL ACETATE, REAGENT GRADE. Used without dilution in the analysis of samples containing DPA or captan.
- C. HYDROCHLORIC ACID 2.0 N. Dilute 41.5 ml of reagent grade HCl to 250 ml with de-ionized water.
- D. SODIUM HYDROXIDE 2.0 N. Dissolve 20 grams NaOH in approximately 200 ml of de-ionized water and then dilute to a total volume of 250 ml with de-ionized water.
- E. HEXANE, REAGENT GRADE. Use without dilution in the analysis of samples containing ethoxyquin.

CAUTION: READ LABEL STATEMENTS ON ALL SOLVENTS AND REAGENTS.

Hydrochloric acid (HCl) and sodium hydroxide (NaOH) are poisonous and corrosive. Ethyl acetate and hexane are highly flammable. Hydrochloric acid and sodium hydroxide should be washed off with copious amounts of water if they splash on skin or clothes. If any solvent or reagent splashes in the eyes, immediately flush with copious amounts of water and see a physician.

III. SAMPLE PREPARATION PROCEDURE FOR DRENCH TANKS CONTAINING THIABENDAZOLE ONLY

- A. Obtain two 100-200 ml samples from each well-agitated drench tank or re-circulating bath. Exercise care to obtain representative samples.
- B. Shake each container vigorously and then pour the contents through 20-30 mesh screen/strainer into the same beaker or remove debris from the suspensions.
- C. Place a magnetic stir bar in the strained suspension and stir vigorously.
- D. Transfer 5.0 ml of the stirred suspension to a 600 ml graduated beaker. Use a syringe fitted pipette to make this transfer.
- E. Add 0.1 HCl to the 500 ml mark. Place a clean magnetic stir bar in the beaker. Stir for 3-5 minutes to dissolve the suspended thiabendazole.
- F. Place a funnel, with filter paper cone, onto a 50 ml Falcon polypropylene centrifuge tube. Pour approximately 20-25 ml of solution from step III-E into the funnel and allow the solution to filter.

NOTE: REFER TO SECTIONS IV. OR V. BELOW IF THE DRENCH OR BATH SOLUTION CONTAINS CHEMICALS OTHER THAN THIABENDAZOLE.

- G. TRANSFER a sufficient quantity of the above filtrate to fill the cuvette to three-fourths capacity. Read the absorbance as instructed in Section VI, PHOTOMETRIC DETERMINATIONS.

IV. SAMPLE PREPARATION PROCEDURE FOR THIABENDAZOLE SUSPENSIONS CONTAINING DPA OR CAPTAN

Ethyl acetate is used to remove DPA or captan from the suspension.

- A. Transfer 20 ml of the filtrate from step III-F above to a clean 50 ml Falcon polypropylene centrifuge tube. Add 7-10 ml of ethyl acetate, cap tightly and shake vigorously (100 times).
- B. After gently swirling the tube, place in the holder and let the phases separate for 5 minutes. Transfer 3-4 ml of the lower (aqueous) phase to a clean cuvette. Read the absorbance as instructed in PHOTOMETRIC DETERMINATIONS (Section VI).

V. SAMPLE PREPARATION PROCEDURE FOR THIABENDAZOLE SUSPENSIONS CONTAINING ETHOXYQUIN

Drenches or baths containing ethoxyquin must be basified, extracted with hexane and re-acidified to remove the ethoxyquin. An 8 to 10 ppm standard should be processed and read in the same manner as the unknown sample to compensate for exchange losses of thiabendazole in the successive cleanup steps.

- A. Transfer 20 ml of filtrate from Step III-F on the previous page to a clean 50 ml Falcon polypropylene centrifuge tube. Add 2.0 ml of 2.0 N NaOH and 10 ml of hexane. Cap tightly and shake vigorously about 100 times.
- B. Warm the tube to about 35° C (95° F) for about 1 minute, swirl gently. Place in the rack and let the phases separate for 5-10 minutes. The lower phase should be nearly clear.
- C. Transfer 10 ml of the lower (aqueous) phase to a clean 50 ml Falcon polypropylene centrifuge tube. Be careful not to transfer any hexane at this step.
- D. Add 1.0 ml of 2.0 N HCl to the tube.
- E. Cap the tube tightly and shake for about 15-20 times. Using a disposable glass pipette, transfer 3-4 ml to a clean cuvette. Read and record the absorbance as instructed in PHOTOMETRIC DETERMINATIONS (Section VI).

VI. PHOTOMETRIC DETERMINATIONS USING THE PHOTOM 302

The PHOTOM 302 is designed to operate from 12 V DC power supply. It will also operate from 110 V AC or 220 V AC when used with a proper rectifier. The light source emits a narrow bandwidth of light in the range required for the detection of thiabendazole.

For optimum stability, the photometer should be turned on at least 30 minutes before use. The sample compartment should be closed except when transferring a cuvette.

CAUTION: Before inserting any cell into the sample holder the cell should be:

1. Wiped dry with a tissue, then wiped clean with a lens tissue. The optical surfaces should be free of any optical interferences (liquid, fingerprints or lint).

2. Covered to prevent spilling acid in the sample compartment. Any spills should be wiped dry IMMEDIATELY.
 - A. Fill a clean cuvette three-quarters full with 0.1 N HCl. Thoroughly dry and clean the outside of the cuvette. Cover the cell and place in the sample holder. Lower the compartment cover gently.
 - B. Flick the RANGE SWITCH to the lower residue range and adjust the zero potentiometer to obtain a scale readout of 0.000 ± 0.001 . Flick the RANGE SWITCH to the upper residue range. It should continue to read 0.000.
 - C. Replace the cuvette containing 0.1 N HCl (blank) with a cuvette containing a mid-range thiabendazole calibration standard, i.e., 8 or 10 ppm. Using the SLOPE CONTROL KNOB adjust the digital readout to read the same as the calibration standard.
 - D. Replacing this calibration standard with other thiabendazole standards, i.e., 2, 4, or 8 ppm, should produce readouts within ± 0.05 ppm of the standard being read. Calibration of the upper range should also calibrate the lower range. However, if the lower range is used exclusively, it should be calibrated with a 1.5 ppm thiabendazole standard.
 - E. TO MEASURE THE ABSORBANCE OF A SAMPLE, transfer a portion of the sample filtrate to a clean cuvette. Read the absorbance on the correct scale. In the equation for calculating the concentration for a drench bath, this value is called ABS.

CAUTION: TO PREVENT SAMPLE-TO-SAMPLE contamination, the cuvette should be drained on absorbent paper: rinsed 3 times with 2 ml portions of the fresh (or next) sample to be read.

VII. CALCULATION OF THE CONCENTRATION OF THIABENDAZOLE IN THE DRENCH BATH SOLUTION

DRENCH BATH TBZ CONCENTRATION (PPM)	$= \frac{ABS \times CCS \times DF}{ACS}$
ABS	- photometer reading of the bath sample from either step III-G, IV-B, or V-E
ACS	- photometer reading of the calibration standard used in Steps VI-C and VI-D, or the 8 or 10 ppm standard processed in Steps V-A to V-E for baths containing ethoxyquin
CCS	- concentration of the calibration standard in ppm used in Steps VI-C and VI-D, or V-A to V-E
DF	- dilution factor should be 100 (i.e., the final volume at Step III-E)

Tank Replenishment Worksheets

The following table provides the amount of Mertect 340-F needed to replenish drench solutions used in treating apples and pears for postharvest molds and rots.

This information should be used only in conjunction with a Mertect Analysis as detailed in the previous pages.

The labeled rate of Mertect 340-F is 16 fl. oz. / 100 gallons, which is equivalent to a thiabendazole drench bath reading of 600 ppm. The following chart provides the amount of Mertect that should be used to replenish (recharge) the tank during normal use.

If your TBZ drench bath reading is	You should add this amount of Mertect 340-F / 100 gallons
<300 ppm	16 fl. oz.
300-400 ppm	8 fl. oz.
400-500 ppm	5 fl. oz.
500-600 ppm	3 fl. oz.

For example:

You sample a 500 gallon tank, and the photometer reading is 350 ppm.

In order to recharge that tank to the 600 ppm rate, add 40 ounces of Mertect to that tank (8 fl.oz./100 X 5).

If the tank is not full, and water is added, Mertect should be added at the rate of 16 fl. oz. per 100 gallons of water added.



Pome Fruit Drench Tank Analysis

Grower Name: _____

Contact: _____ Phone #: _____

Tank Size: _____ gals. Date Sample Taken: _____

If properly mixed at 16 oz. of Mertect 340F per 100 gallons of water, your sample should contain 600 PPM of thiabendazole.

Analysis: _____ PPM of Mertect in this sample

To Recharge tank add _____ ounces of Mertect 340F to your _____ gallon tank.

Remember, if you add water to the tank, add 16 ounces of Mertect 340F to every 100 gallons of water you add.

Notes:

Analysis Date: _____ Conducted by: _____

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Important: Always read and follow label instructions before buying or using this product.
Mertect® is a trademark of a Syngenta Group Company.



Pome Fruit Drench Tank Analysis

Grower Name: _____

Contact: _____ Phone #: _____

Tank Size: _____ gals. Date Sample Taken: _____

If properly mixed at 16 oz. of Mertect 340F per 100 gallons of water, your sample should contain 600 PPM of thiabendazole.

Analysis: _____ PPM of Mertect in this sample

To Recharge tank add _____ ounces of Mertect 340F to your _____ gallon tank.

Remember, if you add water to the tank, add 16 ounces of Mertect 340F to every 100 gallons of water you add.

Notes:

Analysis Date: _____ Conducted by: _____

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Assays for Thiabendazole Residues on Fruit

I. INTRODUCTION

This assay is designed to determine the amount of residue of thiabendazole on treated pome fruit (apples and pears). With minor modifications to the basic procedure, the assay can be used when other chemicals such as captan, diphenylamine (DPA) or ethoxyquin are present on treated fruit.

The assay procedure has a high degree of accuracy, is simple and requires very little time to run. Concentration and residue measurements are derived from the use of a PHOTOM MODEL 302 photometer.

CAUTION: DO NOT use bruised or wounded fruit in the residue assay procedure.

Bruised or wounded fruit will generate inaccurate measurements for residues. The presence of waxes on fruit may interfere with residue readings.

II. SOLUTIONS USED IN FRUIT ASSAYS

- A. HYDROCHLORIC ACID 0.1 N. Dilute 25 ml of reagent grade (12N) hydrochloric acid to 3 liters of de-ionized water.
- B. ETHYL ACETATE, REAGENT GRADE. Use without dilution in the analysis of samples containing DPA or captan.
- C. HYDROCHLORIC ACID 2.0 N. Dilute 41.5 ml of reagent grade HCl (12N) to 250 ml with de-ionized water.
- D. SODIUM HYDROXIDE 2.0 N. Dissolve 20 grams NaOH in approximately 200 ml de-ionized water and then dilute to a total volume of 250 ml with de-ionized water.
- E. HEXANE, REAGENT GRADE. Use without dilution in the analysis of samples containing ethoxyquin.

CAUTION: READ ALL LABEL STATEMENTS ON ALL SOLVENTS AND REAGENTS.

Hydrochloric acid (HCl) and sodium hydroxide (NaOH) are poisonous and corrosive. Ethyl acetate and hexane are highly flammable. Hydrochloric acid and sodium hydroxide should be washed off with copious amounts of water if they splash on skin or clothes. If any solvent or reagent splashes in the eyes, immediately flush with copious amounts of water and see a physician.

III. SAMPLE PREPARATION PROCEDURES FOR FRUIT TREATED WITH THIABENDAZOLE ONLY

In this assay, a weighed amount of fruit (900-1100 g) is washed in a beaker containing 250-350 ml of 0.1 N HCl. The rinsate is then analyzed for thiabendazole in the same manner as the drench bath suspensions.

- A. Weigh out 900-1100 g (2.0 – 2.4 pounds) of whole, UNBRUISED, UNWOUNDED fruit (with stems attached). Avoid large fruit that would not fit in a 600 ml beaker. RECORD THE WEIGHT OF THE FRUIT.
- B. Add 250 ml of 0.1 N HCl to the sample in a 600 ml beaker. Additional 0.1 N HCl can be added to submerge the fruit, if needed. RECORD THE VOLUME USED.
- C. Place the fruit at a 45 degree angle in the beaker. The fruit should be at least 90 percent submerged in the solution. If not, each piece of fruit may be done consecutively in the same solution.
- D. Soak the fruit for 5 minutes. Place the beaker on a magnetic stir plate. Stir at high speed for about 2 minutes.
- E. Stop stirring and remove the fruit by the stem. Drain the fruit over the beaker to minimize loss of solution.
- F. If sample is not complete in Step C, place a fresh apple or pear from the original 900-1100 g sample into the same beaker. Repeat the entire process (Steps III-C to III-E) until all fruit has been rinsed.
- G. After all fruit has been rinsed, check to see if the liquid loss is greater than 20 ml in the beaker. Add enough 0.1 HCl to bring the volume back to the original volume in Step III-B (250 ml).
- H. Place a funnel, with paper filter cone, onto a 50 ml Falcon polypropylene centrifuge tube. Pour approximately 20-25 ml of solution from Step III-G into the funnel and allow the solution to filter.

NOTE: REFER TO SECTIONS IV OR V BELOW IF FRUIT WAS TREATED WITH SOLUTIONS CONTAINING CHEMICALS OTHER THAN THIABENDAZOLE.

- I. Transfer enough of the filtrate from Step III-H to fill a sample cuvette three-fourths of capacity. Read the absorbance as instructed in Section VI, PHOTOMETRIC DETERMINATIONS.

IV. SAMPLE PREPARATION PROCEDURES FOR FRUIT TREATED WITH SUSPENSIONS CONTAINING THIABENDAZOLE AND DPA OR CAPTAN

Ethyl acetate is used to remove DPA or captan from the suspension.

- A. Transfer 20 ml of filtrate from Step III-H above to a clean 50 ml Falcon polypropylene centrifuge tube. Add 7-10 ml of ethyl acetate, cap tightly and shake vigorously (100 times).
- B. After gently swirling the tube, place in the holder and let the phases separate for 5 minutes. Transfer 3-4 ml of the lower (aqueous) phase to a clean cuvette. Read the absorbance as instructed in Section VI, PHOTOMETRIC DETERMINATIONS.

V. SAMPLE PREPARATION PROCEDURES FOR FRUIT TREATED WITH SUSPENSIONS CONTAINING THIABENDAZOLE AND ETHOXYQUIN

Solutions containing ethoxyquin must be basified, extracted with hexane, and re-acidified to remove the ethoxyquin. An 8 to 10 ppm standard should be processed and read in the same manner as the unknown sample to compensate for exchange losses of thiabendazole in Steps V-A to V-E below.

- A. Transfer 20 ml of filtrate from Step III-H above to a clean 50 ml Falcon polypropylene centrifuge tube. Add 2.0 ml of 2.0 N NaOH and 10 ml of hexane. Cap tightly and shake vigorously (100 times).
- B. Warm the tube to about 35° C (95° F), for about one minute, swirl gently. Place in the rack and let the phases separate for 5-10 minutes. The lower phase should be nearly clear.
- C. Transfer 10.0 ml of the lower (aqueous) phase to a clean 50 ml Falcon polypropylene centrifuge tube. Be careful not to transfer any hexane at this step.
- D. Add 1.0 ml of 2.0 N HCl to the tube.
- E. Cap the tube tightly and shake gently 15-20 times. Using a disposable glass pipette, transfer 3-4 ml to a clean cuvette. Read and record the absorbance as instructed in the PHOTOMETRIC DETERMINATIONS section below (Section VI).

VI. PHOTOMETRIC DETERMINATIONS USING THE PHOTOM 302

The PHOTOM MODEL 302 is designed to operate from 12 V DC power supply. It will also operate from 110 V AC or 220 V AC using a rectifier. The light source emits a narrow width of light in the range required for the detection of thiabendazole.

For optimum stability, the photometer should be turned on at least 30 minutes before use. The sample compartment should be closed except when transferring a cuvette.

CAUTION: Before inserting any cell into the sample holder, the cell should be:

1. Wiped dry with a tissue, then wiped clean with lens tissue. The optical surfaces should be free of any optical interferences (liquid, fingerprints or dirt).
2. Covered to prevent spilling acid in the sample compartment. Any spills should be wiped dry IMMEDIATELY.
 - A. Fill a clean cuvette three-quarters full with 0.1 N HCl. Thoroughly dry and clean the outside of the cuvette. Cover the cell and place in the sample holder. Lower the compartment cover gently.
 - B. Flick the range switch to the lower residue range and adjust the zero potentiometer to obtain a scale readout of 0.000 ± 0.001 . Flick the range switch to the upper range. It should continue to read 0.000.
 - C. Replace the cuvette containing 0.1 N HCl (blank) with a cuvette containing a mid-range thiabendazole calibration standard, i.e., 8 to 10 ppm. Using the SLOPE CONTROL KNOB, adjust the digital readout to read the same as the calibration standard.
 - D. Replacing this calibration standard with other thiabendazole standards, i.e., 2, 4, 8 should produce readouts within ± 0.05 ppm of the standard being read.
 - E. Calibration of the upper range should also calibrate the lower range. However, if the lower range is used exclusively, it should be calibrated with a 1.5 ppm thiabendazole standard.
 - F. TO MEASURE THE ABSORBANCE OF A SAMPLE ASSAY, transfer a portion of the sample filtrate to a clean cuvette. Read the absorbance on the correct scale. In the equation for calculating the absorbance of the washed fruit sample this value is called AFS.

CAUTION: TO PREVENT SAMPLE-TO-SAMPLE contamination, the cuvette should be drained on absorbent paper, rinsed 3 times with 2 ml portions of the fresh (or next) sample to be read.

VII. CALCULATING THE FRUIT RESIDUE

$\text{TBZ FRUIT RESIDUE (PPM)} = \frac{\text{AFS}}{\text{ACS}} \times \frac{\text{CCS}}{\text{WFS}} \times \text{DF}$
AFS - photometer reading of the washed fruit from Step III-1, IV-B, or V-E
ACS - photometer reading of the calibration standard from Steps VI-C and VI-D, or the 8 or 10 ppm standard processed in Steps V-A to V-E for fruit treated with ethoxyquin
CCS - concentration of the calibration standard in ppm (i.e., 2, 4, or 8)
DF - dilution factor equals the volume of 0.1 N HCl used in Step III-B (usually 250 ml)

Straight Answers to Important Questions

A Q&A Guide to High-Quality Pome Fruit

Fungicides used postharvest are an integral part of modern pome fruit production. Without them, yield and quality could be severely reduced by the ravages of plant pathogens. But over the years, resistance to these fungicides has increased until, in some cases, their usefulness is threatened. The fact is, fungicide resistance is a reality. The question is how to keep it to a minimum.

Although the resistance problem is potentially serious, it can be managed if pome fruit growers, processors, warehouse personnel, manufacturers and government agencies work together to change the way fungicides are used. The following will address some of the key questions growers ask about fruit-management practices, fungicide resistance, and the use of thiabendazole. It's our hope that the answers will help you better understand resistance and how to develop a sound management program that includes thiabendazole.

Q. What are examples of management practices that will help maintain high-quality fruit?

A. Examples include:

- Harvesting at the proper maturity
- Preventing bruising of fruit at harvest by using proper equipment and training pickers
- Not picking fallen fruit
- Storing fruit in an area where the atmosphere (temperature, humidity, air circulation) can be controlled
- Never make foliar applications of any fungicide that has the same mode of action as a postharvest fungicide that you intend to use. For example, never apply Topsin-M® (thiophanate-methyl) if you plan to use thiabendazole in the packinghouse. These fungicides have the same mode of action and are cross-resistant.
- Never return culls from the packinghouse to the orchard

Q. What are some specific orchard management practices that will help maintain low infection levels?

A. Examples include:

- Pruning dead wood
- Sterilizing bins
- Keeping bins off the soil
- Removing fallen fruit from the orchard
- Applying fungicide appropriately
 - Follow the label (never cut rates)
 - Apply at the proper timing and ensure good coverage

Q. What general packinghouse practices will help keep infection levels low?

A. Examples include:

- Sanitation
 - Keep all surfaces clean by washing with sodium hypochlorite
 - Change dump treatment solution frequently
 - Remove rotten fruit from premises
 - Sanitize bins after dumping fruit
- Storing fruit in areas where the atmosphere can be controlled
- Using thiabendazole properly
- Alternate fungicides with a different mode of action and/or mixtures
- Never return culls to the orchard

Q. Where do the pathogens that cause diseases on pome fruit originate?

A. Spores of the pathogens causing disease may be found virtually everywhere – in the air, soil, bins, trees, fruit and in packinghouses. However, it is important to follow management practices that help keep these spores at low levels. It is also important to minimize the introduction of spores from the field into the packinghouse by sanitizing bins between loads. Do not return culls to the orchard as that further spreads resistant spores to the field.

Q. What is resistance and how does it develop?

A. Resistance is a natural phenomenon that can affect the performance of all fungicides. It is a change in a pathogen that allows the pathogen to tolerate a specific compound. Resistance is a result of a selection process imposed by the use of the fungicide. The longer and more frequently a product is used, the more selection pressure there is on the pathogen. This increases the chances of a resistant pathogen population arising.

Q. Does the fungicide's mode of action have any impact on the development of resistance?

A. Yes. A fungicide can have either a single-site or multi-site mode of action. Benzimidazole fungicides are known to have a single-site mode of action.

Q. Is thiabendazole a benzimidazole?

A. Yes, thiabendazole is a benzimidazole and has the same mode of action as other benzimidazoles including benomyl (Benlate) and thiophanate-methyl (Topsin-M). All of these fungicides are cross-resistant with one another.

Q. Have *Penicillium*, *Botrytis* and/or *Gloeosporium* developed resistance to thiabendazole?

A. Resistance of these pathogens has been documented.

Notes:



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