



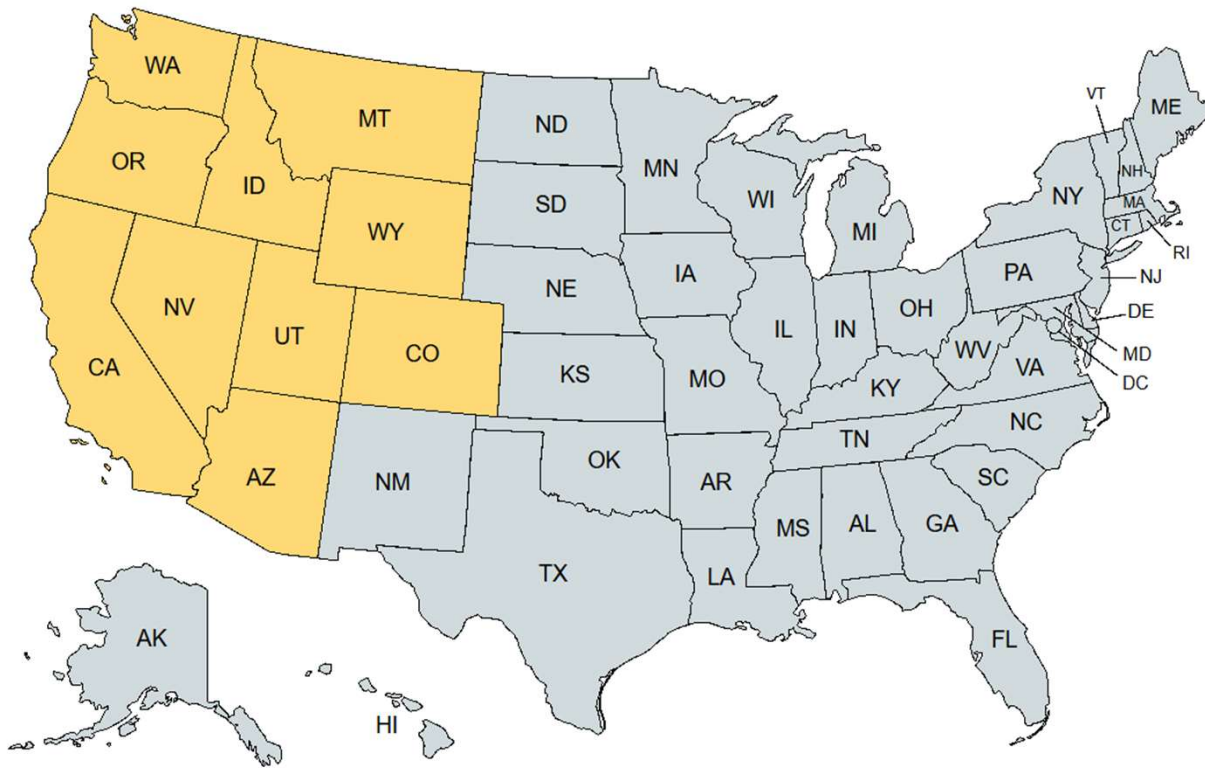
**WILBUR-ELLIS**

**Don Frantz, Wilbur-Ellis Branded Products**  
**Phosphites and Harpin Proteins**

# Don Frantz

## Branded Technologies Territory Manager

208.579.8506



# PHOSPHITES



# Discussion Topics

**What are phosphites chemically?**

**Phosphites as fertilizers**

**Plant physiological responses to phosphites**

**EPA-registered Phosphite Fungicides**



# Phosphites Overview

# Phosphate vs. Phosphite

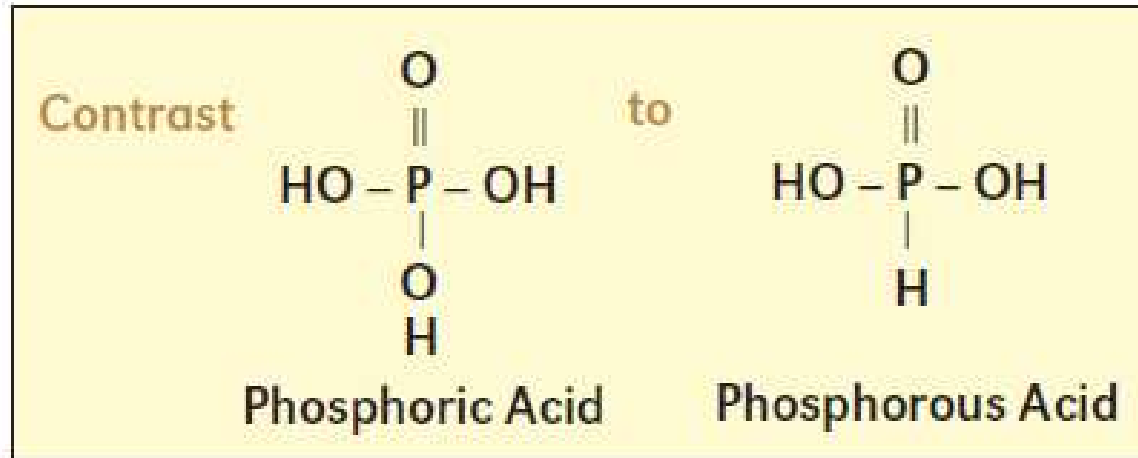
## Phosphate

- Essential plant nutrient – “Energizer” Nutrient
- Phosphate ( $\text{H}_2\text{PO}_4^-$ ) absorbed and incorporated into cells
- Forms ATP (high energy molecule) structural components of cell membranes (phospholipids), and DNA.
- It is essential for root & shoot growth, photosynthesis, and cell division

## Phosphite

- Phosphite is more soluble than phosphate, making leaf and root uptake more efficient
- Phosphite supplied through the soil or foliage is slowly converted to phosphate\*
- Soil and foliar applications are made at relatively low rates
- For some plant species, phosphite may offer some unique benefits not seen with phosphate applications.
- Phosphites ( $\text{PO}_3$ ) are reactive molecules, forming insoluble salts (precipitates)

# Phosphite Chemistry



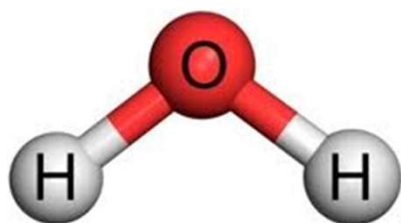
Phosphate  
 $\text{PO}_4$

Phosphite  
 $\text{PO}_3$

How is it made?

Potassium Hydroxide + Phosphorous Acid = **Potassium Phosphite**

# How Much Difference Does a Single Atom of Oxygen Make?



**Water**

- Without it, life ceases to exist



**Hydrogen Peroxide**

- Potent Biocide



# Key Facts of Phosphites & Their Benefits

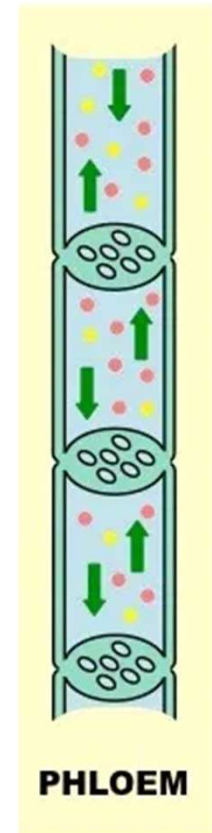
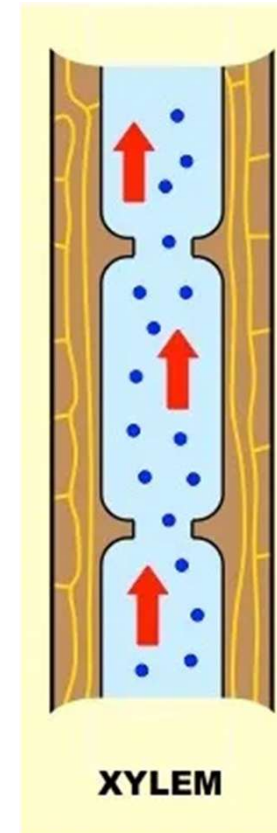
**Continue** Phosphate applications – inadequate plant tissue phosphate levels will reduce phosphite efficacy

**Readily** absorbed by both leaf and root tissues -  
Can act as a transport vessel/accelerator for tank mix partners

**Move** freely through the Xylem and Phloem -  
Foliar applications to target root growth/pathogen pressure and vice versa

**Will** gravitate towards new growth of the crop –  
time the phosphite application accordingly to achieve desired response

**Can** influence Nitrate Reductase Enzyme activity –  
key enzyme in Nitrogen metabolism and conversion of Nitrate to Nitrite



# Phosphite Mode of Action

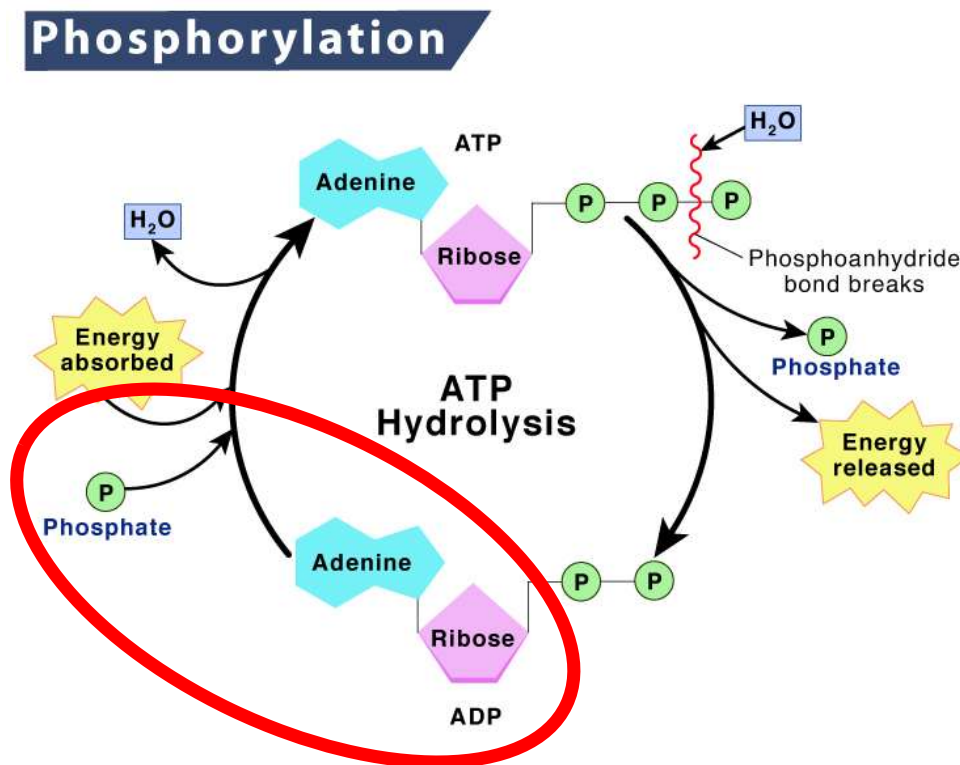
Phosphonate family FRAC P07

Direct effect on oomycetes - *Phytophthora*, *Pythium* and Downy Mildew

- Inhibits addition of phosphate to organic compounds to make them usable for living cells

Induces a Systemic Acquired Resistance (SAR) response – natural defense system of the plant & increases plant vigor

Stimulates the Shikimic Acid Pathway – Same pathway that Glyphosate inhibits in plants



# What About the Potassium?

Potassium Hydroxide + Phosphorous Acid =

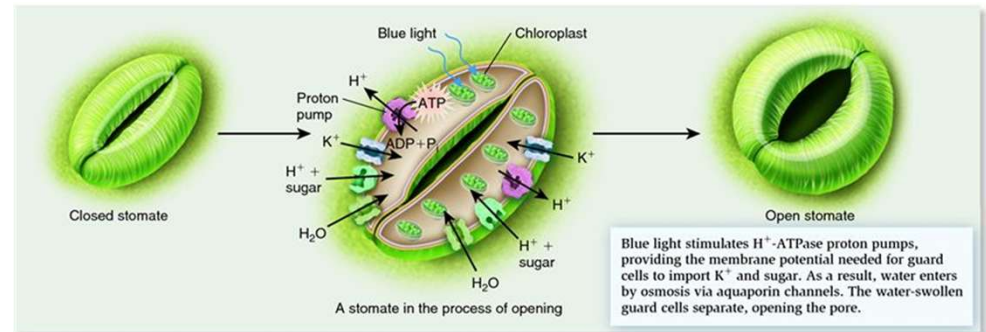
## Potassium Phosphite

More than just a phosphite - Excellent foliar potassium source

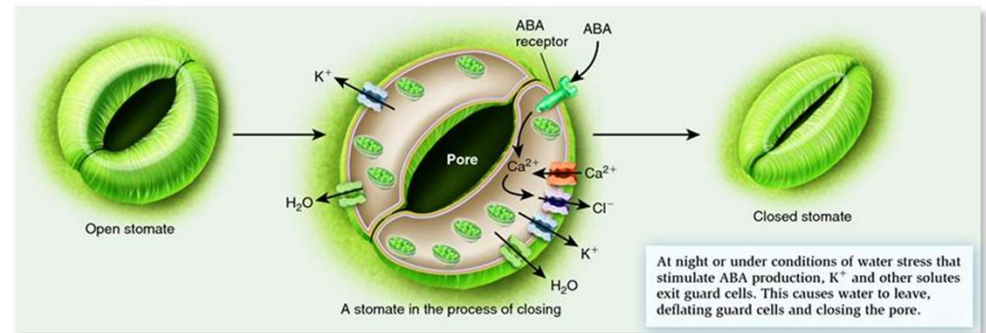
Sufficient potassium levels help regulate stomatal function and maintain optimal photosynthetic activity - increased tolerance to environmental stressors

- High K in Stomates = Open
- Low K in Stomates = Closed
- Inadequate K in Plants = Sluggish Stomates

Adequate K levels strengthen cell structure – Increased stalk strength

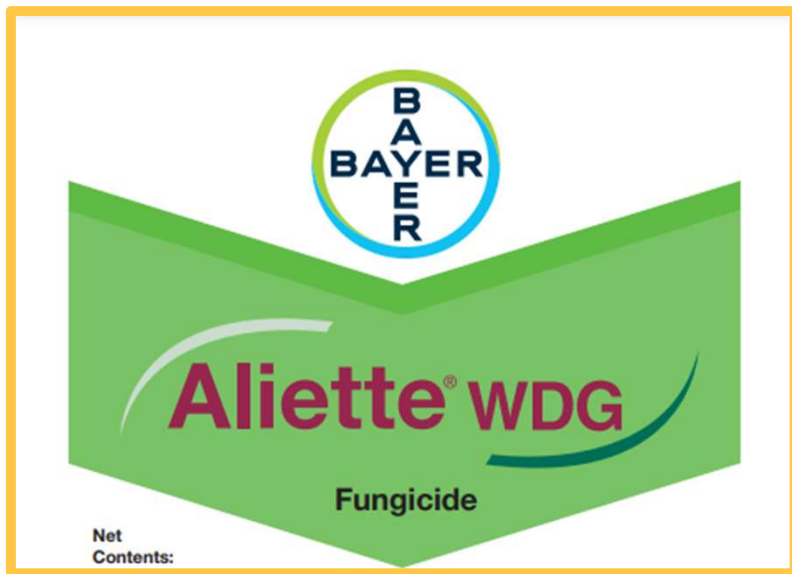



(a) The process of stomate opening



(b) The process of stomate closing

# How many of us recognize this product?



-  **SPARRA™** behaves in similar manner – moves through both Xylem and Phloem.
- Both are part of the phosphonate fungicide family, mitigating impacts of *Phytophthora*, *pythium* and other oomycetes
- Both broad spectrum fungicides – think Amoxicillin for human medication

# History of Phosphites in Agriculture

**50' s & 60' s: Phosphite determined to be converted biologically to phosphate**

**70' s & 80' s: work concentrated on fungicidal activity on *Pythium* and *Phytophthora* spp.**

**90' s: Plant Health aspects and non-fungicidal aspects of Phosphites**

**Present Day: Both Fungicidal and Plant Vigor uses are market drivers**

# Phosphites in Plants

- **More readily absorbed as a foliar than phosphate**
- **Rapidly translocates to roots from foliar absorption**
- **Foliar treatment may increase floral intensity, yield, fruit size and soluble solids**
- **Stimulates sugar metabolism and other metabolic pathways**
- **Induces production of biologically active metabolites**

# Phosphite Activity as Nutrient

Phosphite is not a primary source of phosphorus to plants

Soil microbes can convert  $\text{PO}_3$  to  $\text{PO}_4$

$\text{PO}_3$  is more readily absorbed foliar than  $\text{PO}_4$

$\text{PO}_3$  absorbed by roots and foliage

Data shows that  $\text{PO}_3$  initiates “soil-mining” by plants due to mimicking phosphate starvation

$\text{PO}_3$  applied prior to flowering/fruit-set can overcome phosphate stress

# Phosphite Registration Status

## States That Do

MaxSet 31 0-31-28

$P_2O_5$  from  $PO_3$  can be claimed in the guaranteed analysis

## States That Do Not

MaxSet 28 0-0-28

$P_2O_5$  from  $PO_3$  cannot be claimed in the guaranteed analysis



# Foliar Phosphorous Phosphite – Regulatory Considerations

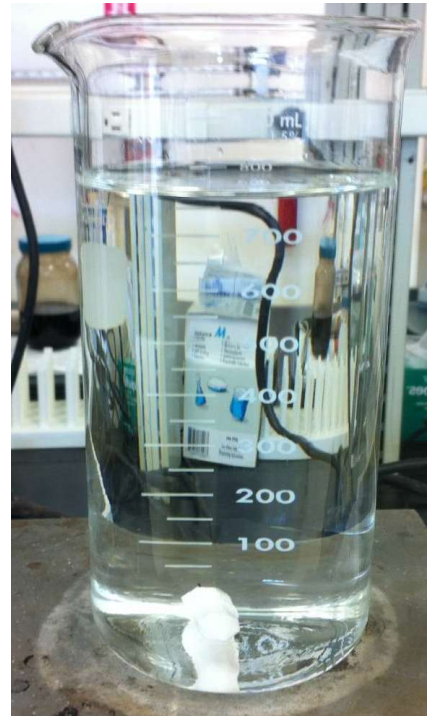
## What Can Be Said?

- Phosphorous acid or phosphite fertilizers are approved and commercially available
- Phosphorous acid or phosphite products are NOT substitutes for fungicides unless specifically registered for such use
- Phosphorous acid or phosphite fertilizers provide nutritional value and may contribute to plant vigor

# **PO<sub>3</sub> Compatibility/Incompatibility**

Ca, Mg, Fe, Mn, Zn  
have issues  
depending on pH,  
concentration and  
chelation

**Copper fungicides  
(Badge)  
incompatible**



MaxSet 28, 1 Qt/50G

# **PO<sub>3</sub> Compatibility/Incompatibility**

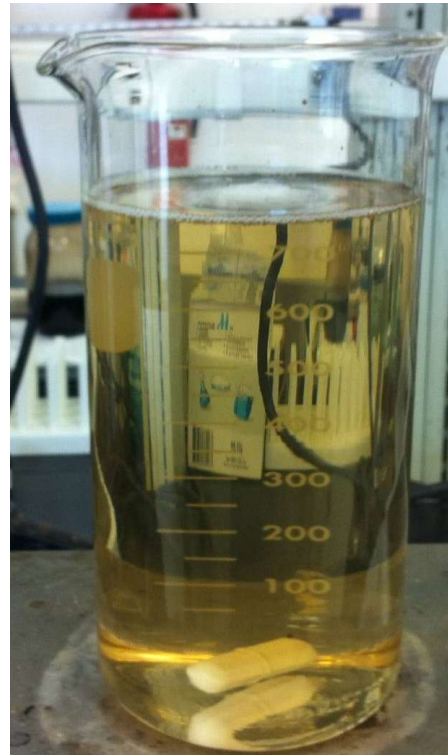
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MaxSet 28, 1 Qt/50G  
plus 1 Qt FG Zinc 10%

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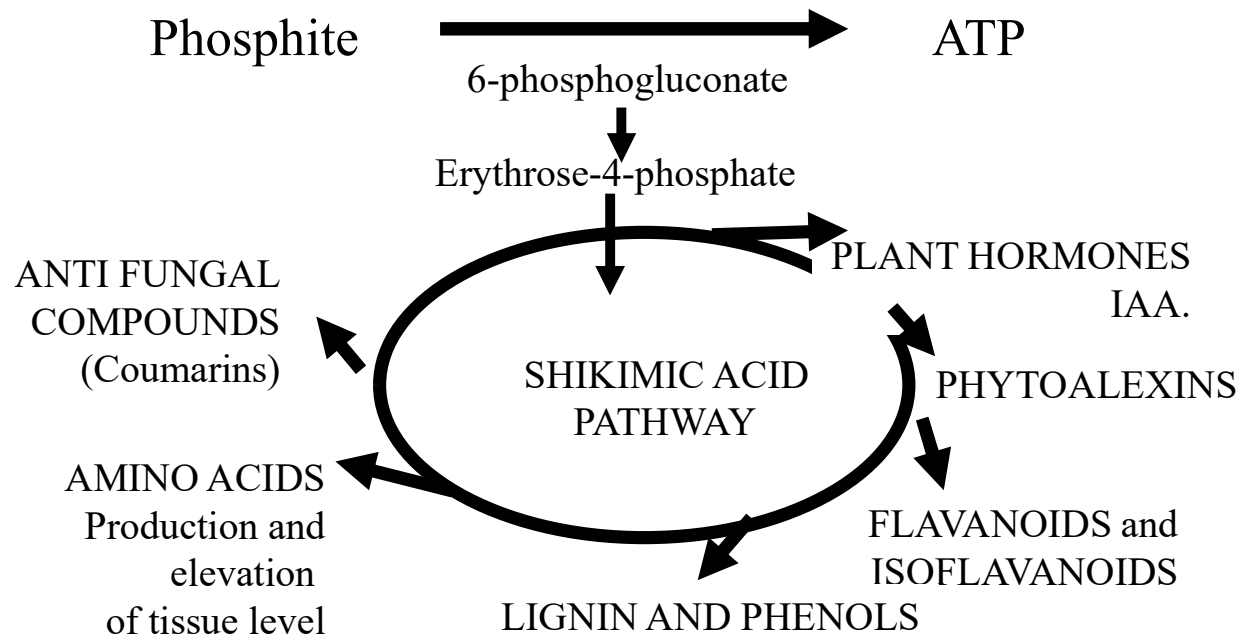


MaxSet 28, 1 Qt/50G  
plus 1 Qt FG Zinc 10%  
and 1 Qt Tri-Fol

# PHOSPHITES AS EPA-REGISTERED FUNGICIDE



# Shikimic Acid Pathway



**Glyphosate inhibits this pathway**  
**Phosphites stimulate this pathway**

# Phosphite as a Plant Vigor Aid

## Shikimic Acid Pathway

Produces plant hormones

Essential Amino Acids

Phytoalexins

Coumarins

Flavanoids

Lignins and Phenols

# Fungicidal Properties

Example: pythium on bent

Peter Landschoot, PhD  
Penn State





# Phosphites Recap



Phosphites are **not** the same as Phosphate – Adequate tissue phosphate levels necessary for appropriate Phosphite response

Phosphites are more than a potassium fertilizer – Dual Mode of Action through SAR Induction and reduction in phosphate metabolism on Oomycetes

Move systemically through the plant and can increase plant vigor and overall plant health

Max Set 31 or Max Set Nurish is best used when nutrient translocation is desired as well as stimulating natural plant growth stages

Sparra is recommended to be used when *Phytophthora*, *Pythium*, or Downy/Powdery Mildew are present or can proactively prime plant for pathogen

# SPÄRRA

Group P07 fungicide  
EPA registered 2935-560



**BRANDED TECHNOLOGIES**  
& BIOLOGICAL SOLUTIONS

THE POWER OF WE®



**WILBUR-ELLIS**  
AGRIBUSINESS



#### Diseases Controlled: Oomycetes/water molds

- 1 *Phytophthora*
- 2 *Pythium*
- 3 Powdery mildew
- 4 Downy mildew

# SPÄRRA

Phite back faster

#### What is it?

- FRAC P07 Fungicide
- Broad Spectrum Systemic Control
- 59.24% Mono and Di-Potassium salts of Phosphorous Acid
- REI of 4 hours, PHI of 0 Days
- PPE Required

#### Benefits

- 1 Highest Concentration of EPA Registered Potassium phosphite on the market
- 2 Dual MOA through Activating plants natural defense mechanisms & reduction in phosphate metabolism in oomycetes
- 3 Excellent rotation chemistry to help with disease resistance management

# Product Description

A systemic fungicide-bactericide for the control of various plant diseases on agricultural crops (including those grown for seed), greenhouse crops (including those grown in shade house, lath house, and controlled environments), turf and ornamentals, and for post-harvest treatment.

GROUP	P07	FUNGICIDE
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- **Signal word:** Caution
- **REI:** 4 hours
- **PPE:** Long-sleeved shirt and long pants, shoes plus socks, waterproof gloves and protective eyewear
- **Active Ingredients:**
  - Mono- and di-potassium salts of Phosphorous Acid\* (FRAC P07)
- **Resistance management:** Rotate within a growing season with different groups that control the same pathogens, use tank mixtures with fungicides from a different group and adopt an integrated disease management program
- **Use** as a prevention of disease program and a disease control program



A systemic fungicide-bactericide for the control of various plant diseases on agricultural crops (including those grown for seed), greenhouse crops (including those grown in shade house, lath house, and controlled environments), turf and ornamentals, and for post-harvest treatment.

#### ACTIVE INGREDIENTS:

Mono- and di-potassium salts of Phosphorous Acid*	59.24%
OTHER INGREDIENTS	40.76%
TOTAL	100.00%

\* Contains 7.60 lb/gal of the active ingredients, mono- and di-potassium salts of Phosphorous Acid. Equivalent to 4.79 lb Phosphorous Acid/gal.

EPA Reg. No. 2935-560

EPA Est. No. 2935-CA-36

KEEP OUT OF REACH OF CHILDREN  
**CAUTION**

## • How Does it Work?



- Broad-Spectrum Systemic control of Downy Mildew, Powdery Mildew, *Pythium*, *Phytophthora* and many other key diseases in agricultural and greenhouse crops, turf and ornamentals, and conifers and other trees.
  - Key Application Interval
    - Disease Prevention Program: Apply the lower specified rate at 7-28 day intervals after plants become established. Do not apply SPARRA at intervals less than 3 days.
    - Disease Control Program: Apply the higher specified rate at 7-14 day intervals until control is reached. Under severe circumstances, application can be made at intervals of up to every three days. Do not apply SPARRA at intervals less than 3 days. Consult with Farm Advisor, Licensed Agricultural Pest Control Advisor or Certified Crop Advisor to determine disease severity.
- Consistent protection of leaf tissue

### Product Highlights

- Contains 59.24% Mono- and di-potassium salts of Phosphorous Acid, making it the highest concentration of any EPA registered Potassium Phosphite on the market.
- Broad-Spectrum Systemic Fungicide-Bactericide Control for Downy Mildew, Powdery Mildew, *Pythium*, *Phytophthora* and many other key diseases
- Unique formulation improves upon a well established and efficacious active ingredient.
- Exceptional Efficacy with low use rate/acre
- Long term shelf-life stability



# Broad Label Uses!

SPÄRRA is used for control of labeled diseases in turf and ornamentals grown in outdoor field and container nurseries, greenhouses, lath or shade houses, conifer plantations, commercial and residential landscapes, interiorscapes, parks, athletic fields, and golf courses.

## ORNAMENTALS

Including, but not limited to, Aglaonema, Aphelandra, Arborvitae, Ash, Azaleas, Bougainvillea, Boxwood, *Cattleya skinneri*, Cedars, Ceanothus, Cotoneaster, Cissus, Dieffenbachia, Dogwood, Ferns, Ficus, Flowering Trees, Hibiscus, Hard Wood Trees, Holly, Home Lawns, Juniper, Magnolia Trees, Maple, Pines, Oaks, Palms, Peperomia, Photinia, Pittosporum, Philodendron, Pieris, Pothos, Redwoods, Rhododendron, Roses, Schefflera, Sedum, Sempervivum, Shrubs, Spathiphyllum, Sycamore, Taxus media, Zygocactus.

**NOTE:** Refer to **APPLICATION PROGRAM** above for disease prevention and control programs.

## BEDDING PLANTS

Including, but not limited to, Ageratum, Algerian Ivy, Alyssum, Anthurium, Artemisia, Aster, Baby's Breath, Begonia, Caladium, Carnation, Chrysanthemum, Coleus, Columbine, Daisy, Delphinium, Easter Lily, English Ivy, Foxglove, Gaillardia, Geranium, Gloxinia, Impatiens, Marigold, Pansy, Petunia, Phlox, Pinks, Poinsettia, Primrose, Prostrate Rosemary, Salvia, Snapdragon, Verbena, Vinca, and Zinnia.

**NOTE:** Refer to **APPLICATION PROGRAM** on page 21 for disease prevention and control programs.

# Broad Label Uses!

## TURF

Including, but not limited to, turf grasses on sod farms and lawns, commercial turf production, golf courses (including tees and greens), parks and commercial landscapes.

**NOTE:** Refer to **APPLICATION PROGRAM** on Page 21 for disease prevention and control program.

DISEASE	APPLICATION METHOD	RATE/APPLICATION
Alternaria Anthracnose ( <i>Colletotrichum graminicola</i> ) Cercospora* Helminthosporium Phytophthora* Pythium (Yellow Turf) Rhizoctonia Sclerotinia  * <i>Not for use in California</i>	Foliar Spray	2-3 fl oz per 1,000 square feet in a minimum of 2 gallons of water. Apply at 10- to 21-day intervals.
	Chemigation	2-3 quarts per acre in a minimum of 100 gallons of water. Apply with normal irrigation schedule at 10- to 21-day intervals.

- Begin preventive applications when conditions first favor disease. Use higher rates under severe disease conditions.
- Do not mow or irrigate treated areas until sprays have completely dried.
- Do not graze livestock on treated turf.
- Do not feed clippings from treated turf to livestock and poultry.