

Fungicides 101



Folicur[®]



Bravo 500



Fungicide: A chemical substance that destroys or inhibits the growth of fungi

Product name: Every pesticide has a product name or a trade name.

active ingredient: chemically active component of a formulated product usually doubles as the common name of the product



e.g. Quadris[®], Abound[®]
active ingredient: azoxystrobin
common name: azoxystrobin

Pesticide labels

Note: Section 18 label will differ from Section 3 label

By law, certain kinds of information must appear on a pesticide label. People who use pesticides have the **LEGAL** responsibility to read, understand and follow the label directions.

Type of info on label includes:

- Hazards to humans and animals, environment
- Agricultural use requirements
- Storage and disposal
- Management –resistance, spray drift
- Spraying and mixing
- Tank mix compatibility

Categories

- chemical group
- mode of action
- breadth of activity
- mobility within the plant
- role in protection

Chemical group:

- name given to a group of chemicals that share common mode of action
 - e.g. Strobilurins – inhibit respiration
 - Triazoles – inhibit sterol biosynthesis
- may or may not have similar chemical structure

Mode of action (MOA)

Fungicides kill by:

- Damaging cell membranes
- Inactivating critical enzymes or proteins
- Interfering with key metabolic processes, e.g. respiration

IMPORTANT:

Know mode of action of fungicide because:

- know which diseases can be controlled by the fungicide
- use different MOA in disease management program to delay fungicide resistance development

Breadth of activity

Single-site:

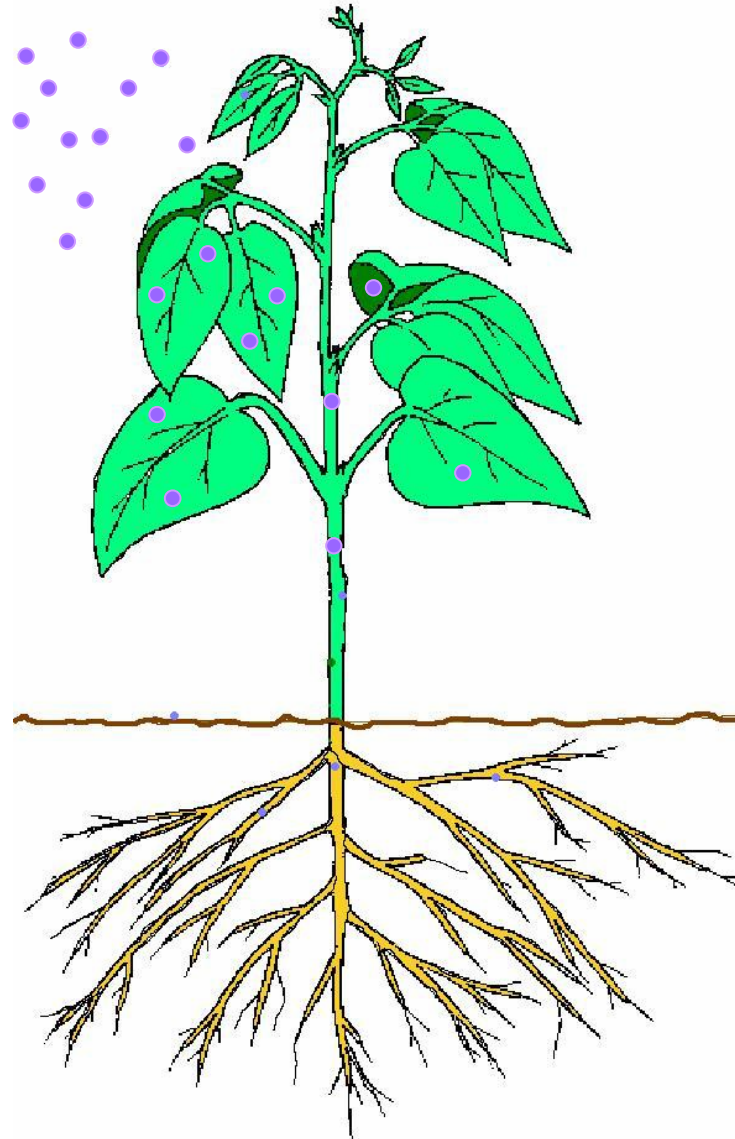
- active against only one point in one metabolic pathway of pathogen or a single enzyme or protein needed by the fungus
 - e.g. specific enzyme: demethylase – triazoles
succinate dehydrogenase -strobilurins
ubiquinol oxidase – carboxamides
- highly specific therefore increased chance of fungus becoming resistant

Multi-site:

- e.g. chlorothalonil

Mobility within the plant

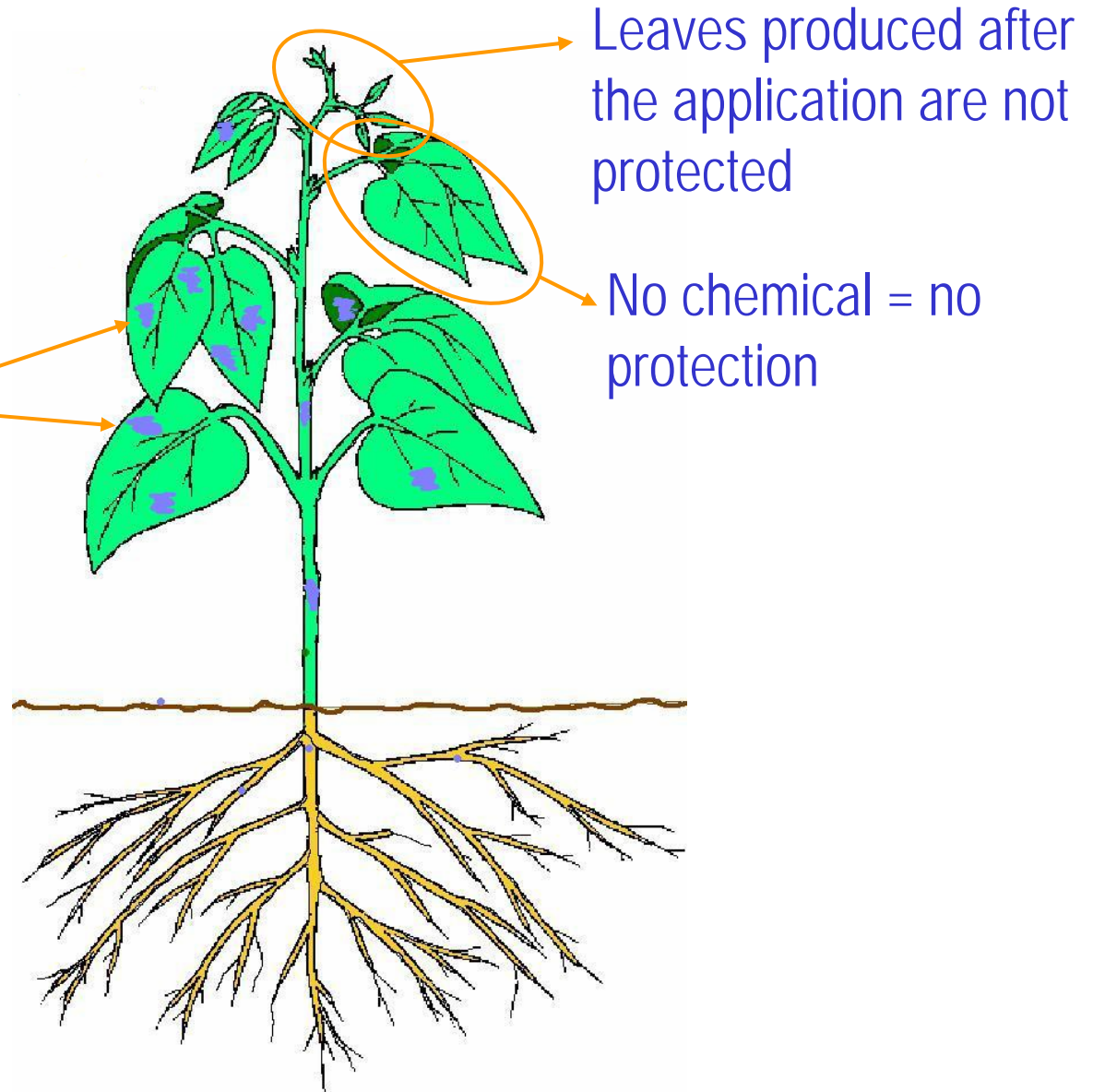
Fungicide applied



Mobility within the plant

Contact
(protectant)

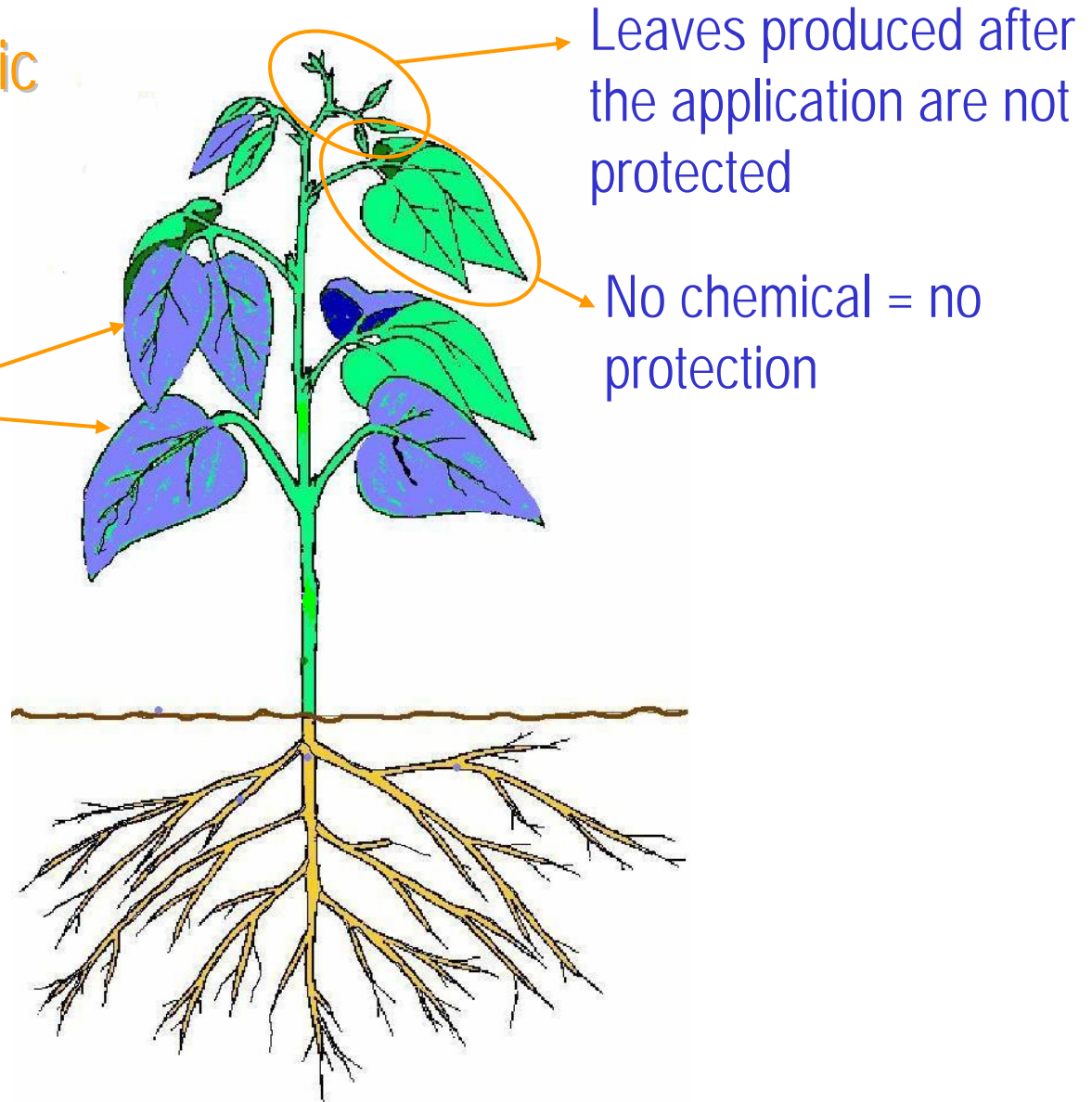
Droplets spread out on the surface where deposited; do not move inside



Mobility within the plant

Locally systemic
(translaminar)

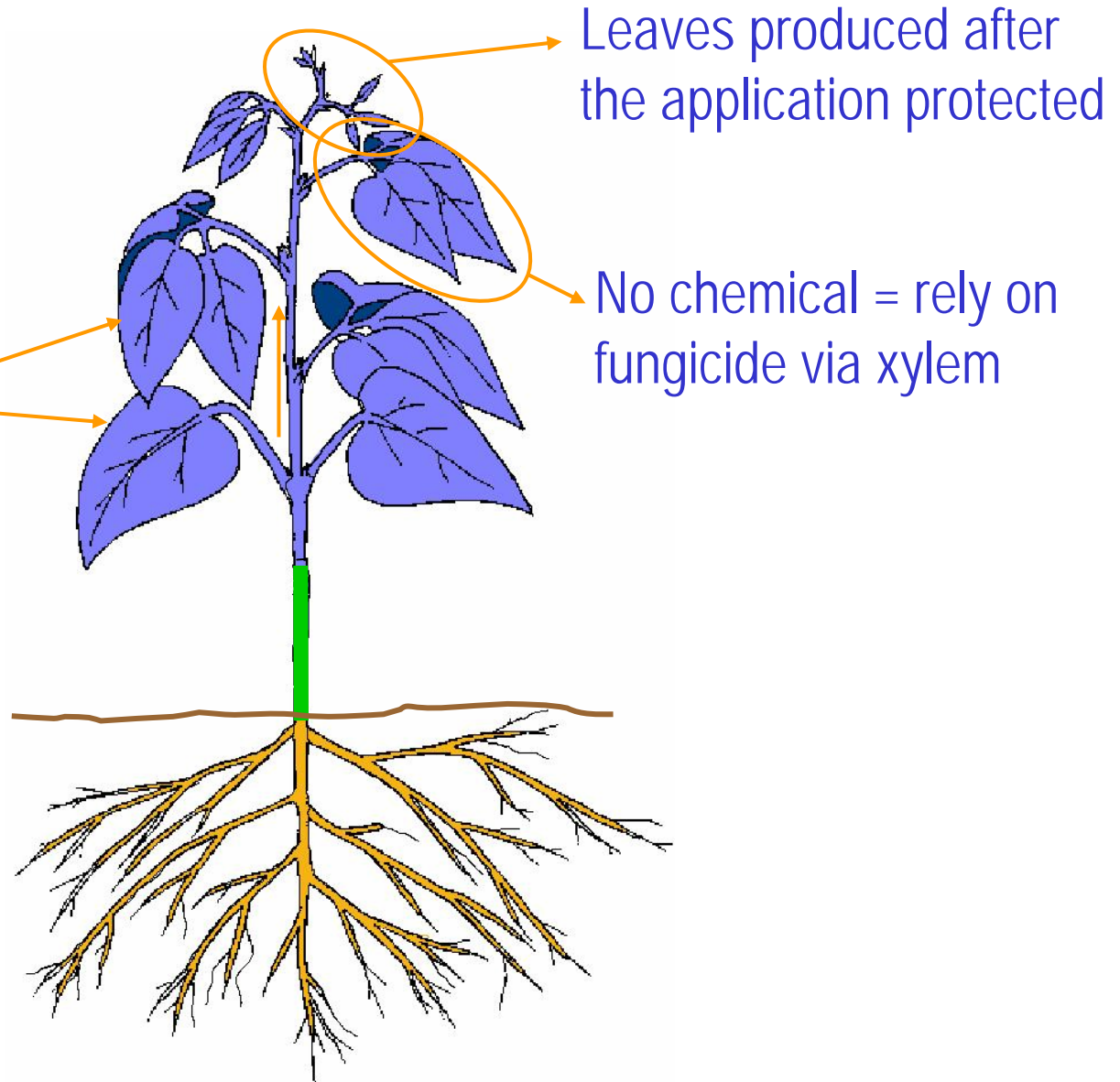
Droplets spread out on
and move inside leaf
tissue = external and
internal protection



Mobility within the plant

Systemic
(acropetal)

Droplets spread out on and move inside leaf tissue = external and internal protection;
Fungicide on the stem moves upwards in the xylem to new growth



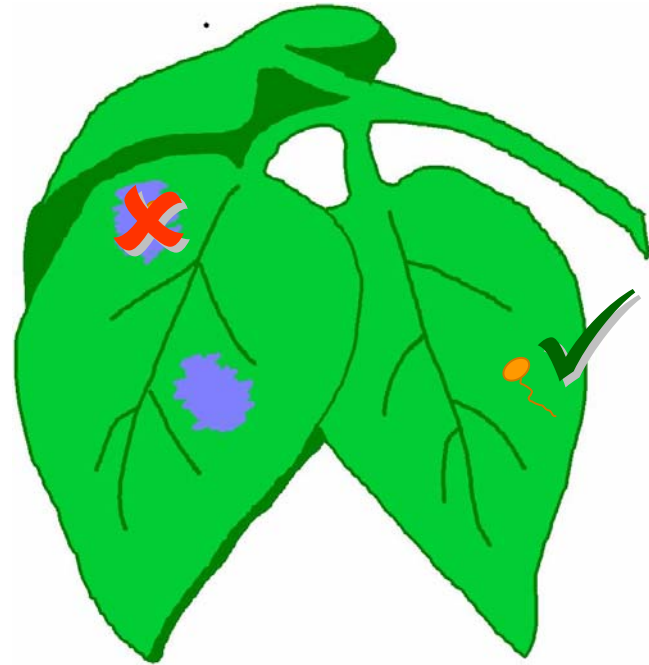
Leaves produced after the application protected

No chemical = rely on fungicide via xylem

Role in Protection

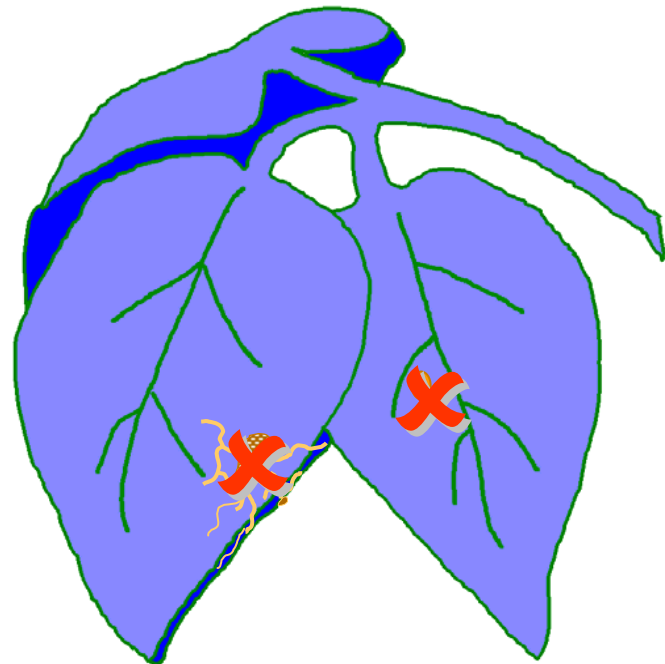
Preventative:

- contact action
- prevent spore germination and infection
- contact and systemic fungicides



Curative:

- kill mycelium and fruiting bodies within the leaf
- systemic fungicides



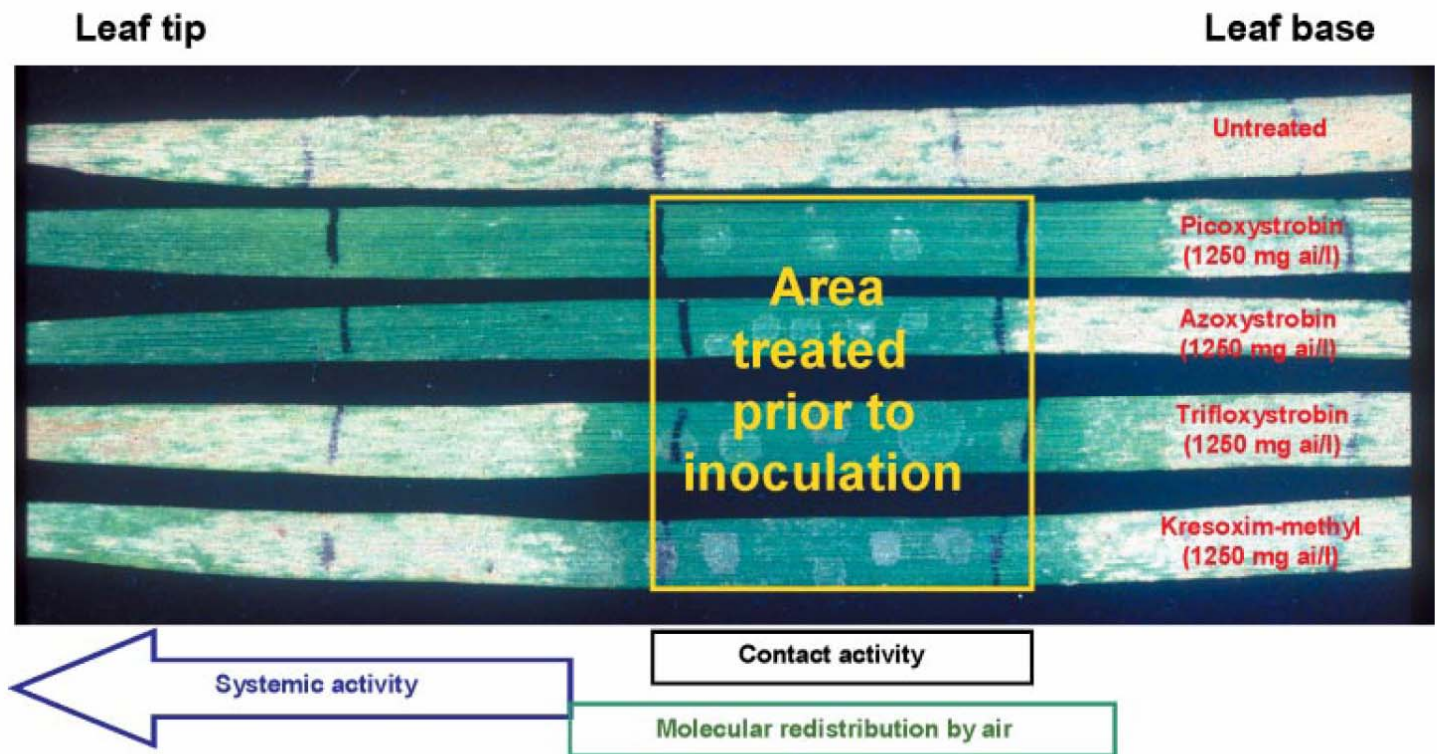
Strobilurins (= QoI fungicides)

- Common mode of action (inhibits respiration) but definite practical differences:

	azoxystrobin e.g. Quadris [®]	pyraclostrobine e.g. Headline [®]	trifloxystrobin e.g. in Stratego [®]
Uptake into leaf	low	very low	very low
Metabolic stability within leaf	yes	yes	yes
Translaminar movement	yes	low	low
Xylem systemic	yes	no	no
Phloem mobile	no	no	no

Redistribution of strobilurins in wheat to control PM

Bartlett et al, 2002



e.g. Quadris ®

e.g. in Stratego ®

Strobilurins (cont.)

- Broad spectrum
- Inhibit spore germination therefore excellent preventatives
- Best time to apply: prior to infection or very early stages of disease development

Bartlett et al, 2002

- Quadris[®] = 22-30d activity
- Even at lowest recommended rate = Quadris[®] most expensive treatment for rust (could this result in growers using reduced rates?)

Draper et al, 2004

Strobilurins (cont.)

Additional effects

- “greening effect” – maintain green leaf area longer
- Cereal fungicide programs: stobilurin-based vs triazole-based
 - disease control = similar
 - yield response = different
- two hypotheses:
 1. Physiological – e.g., PS activity, chlorophyll content, plant hormone levels, nitrate reductase activity, ethylene biosynthesis
 2. Stops host defense response (energy demanding)
- Soybean ???

Triazoles (= DMI fungicides)

- common mode of action (inhibit cell membrane ergosterol synthesis)
- Broad spectrum
- does not prevent spore germination and early germ tube growth because reserves in spore
- Rapidly penetrates young leaf and stem tissue (↑ warm T°)
- Xylem systemic – i.e. upward movement
- $T_{1/2}$ inside plant = 14 days
- Must be inside plant tissue to be absorbed by fungus

Keys to Soybean Rust Control Summary

- Preventative is key (Preventative, Not Curative)
 - If lesions or pustules are present its too late for preventative – Must have curative MOA included
- Two MOA's are best overall program in Brazil
- Strobilurins have long residual and give preventative control
- Triazoles provide strobilurins a short curative affect to stop sporulation on current foilage

Prevention, Protection, Profit

Strobilurins

Fungicide MOA's for SBR Control

- Pyraclostrobin (Headline) best strobi in rust efficacy and duration of control
- Preventative application is KEY
- Provide control of germinating spores prior to infection
- Little control of existing infections once in plant
- Offer residual control to prevent new infection
 - New foliage requires new application

Relative SBR control as part of program

Pyraclostrobin > Azoxystrobin >> Trifloxystrobin

= Headline® > Quadris® >> one of a.i. in Stratego® 

Triazoles

Fungicide MOA's for SBR Control

- Provides control of existing infections
- May prevent sporulation from internal infections
- Short residual 7-10 days
 - New foliage requires new applications
 - Will not prevent new infections unless multiple applications
 - Propiconazole limited to 2 applications with Section 18 exemption
- Triazole rates raised to highest max levels on label
 - Ex: Propiconazole 4-8 oz/a vs. 2-4 oz for other uses

Relative SBR control

Metconazole = Tebuconazole = Tetraconazole > Mycobutanil >> Propiconazole

? = Folicur ® = Domark™ > Laredo™ >> **Headline**
Tilt (®/Propimax™ /Bumper ®/a.i. in Stratego ®

Alternatives to fungicides

Brazil – rotation with corn

avoid volunteer soybeans (inoculum source)

plant early maturing varieties (avoidance)

“look promising”

J. Yorinori

Zimbabwe – breeding program:

in progress

adjust planting date:

unsuccessful

South Africa - plant spacing (between row and density)

no benefit

different maturity groups

maybe???

Rouging infected plants

Soybean Rust: Management Options
Kent L. Smith, Ph.D.
USDA, Office of Pest Management Policy
May 11, 2004

Other foliar fungicides registered in U.S. on legumes
(some for organic use?)

- carbonic acid, monopotassium salt (Armicarb) – soybeans, lima beans, green beans, dry beans
- cinnamaldehyde (Cinnacure) – soybeans (for rust)
- coppers – soybeans, lima beans, dry beans, green beans
- harpin (Messenger) – soybeans, dry beans
- hydrogen peroxide (Rezistox) – dry beans (for rust)
- neem oil – soybeans (for rust)

Soybean Rust: Management Options
Kent L. Smith, Ph.D.
USDA, Office of Pest Management Policy
May 11, 2004

Other foliar fungicides - Continued

- potassium phosphate, monobasic (Nutrol) – soybeans, lima beans, dry beans
- potassium salts of fatty acids (M-pede) – soybeans
- sulfur – soybeans; lima beans, dry beans, green beans, and cowpeas (for rust)
- thiabendazole (Mertect) – soybeans
- thiophanate-methyl (Topsin M) – soybeans
- ziram – lima beans

Avoiding Resistance

- Limit number of sprays
- Spray only when needed
- Spray early when populations small
- Use proper rates; ensure good coverage
- Rotate with different MOA and non-systemic compounds
- Mix with different groups or non-systemic compounds

Suggested product use regime (National Soybean Rust Working Group NC504)

Growth stages: R1 (flowering) – R5 (full pod)

A. Preventative / Conservative

Reliable reports – rust potential high in your area but not yet detected locally

1 st application:	strobilurin or premix product *
2 nd application (If needed) : (3 weeks after 1 st application)	triazole or chlorothalonil
3 rd application (If needed) : (2 weeks after chlorothalonil) (3 weeks (premix used 1st applic.))	triazole strobilurin

* Section 18 still pending

Proposed edits (Monte Miles) to NC504 scenarios:

1. Sipcam Agro – chlorothalonil only use before rust is present
2. Strobilurins should only be used as preventatives
3. FRAC (Fungicide Resistance Action Committee) recommendations (and section 18 requirements!):

* total of 2 applications of strobilurin and or triazole per season *

Therefore no 3rd application unless chlorthalonil used 1st

Suggested product use regime (National Soybean Rust Working Group NC504)

Growth stages: R1 (flowering) – R5 (full pod)

C. Curative

Rust is present at low levels in lower to mid-canopy in yours or a neighbor's fields

1st application: triazole

2nd application (If needed) :
minimal level disease

strobilurin
premix product *

3rd application (If needed) :

chlorothalonil

* Section 18 still pending

BASF Recommendation

Asian Soybean Rust

Rust NOT Present in Field or Area

Application 1: Headline 6-12 oz/acre + adjuvant

*R1 – R3 stage

Application 2: Headline 6 oz/acre + Triazole + Adjuvant

* 21-28 days after 1st application or monitoring shows disease (if required)

Rust Present or Suspected in Field or Area

Application 1: Headline 6-12 oz/acre + Triazole + adjuvant

*Monitoring shows disease or local presence of spores

Application 2: Headline 6 oz/acre + Triazole + Adjuvant

* 21-28 days after 1st application or if monitoring shows disease

- **Headline residual activity prevents rust spore germination**
- **All triazoles compatible with Headline**
- **Triazole provides curative control of infections occurring on new foliage emerged since 1st application**

Headline

Headline not registered for use on soybeans yet!!!

Timeline to assess the risk of soybean rust for a growing season

X.B. Yang (see www.soybeanrust.info)

January }
February } Assessments = little value

March monitor information for rust outbreaks in Florida and S. Texas

Critical { April }
May } Rust in LA, MA or AL - spores likely to reach NC region by July

June Rust in LA, MA or AL - still important but decreased risk

July }
August } normal to below normal T° }
normal to above normal moisture } Increased risk for NC region