Fungicide Applications to Mitigate Soybean Stress

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Agenda

- Fungicidal seed treatments
- Foliar fungicide applications
- Choosing the correct product and application method
- Research results

Introduction to fungi and fungicides

Plant Pathology 101

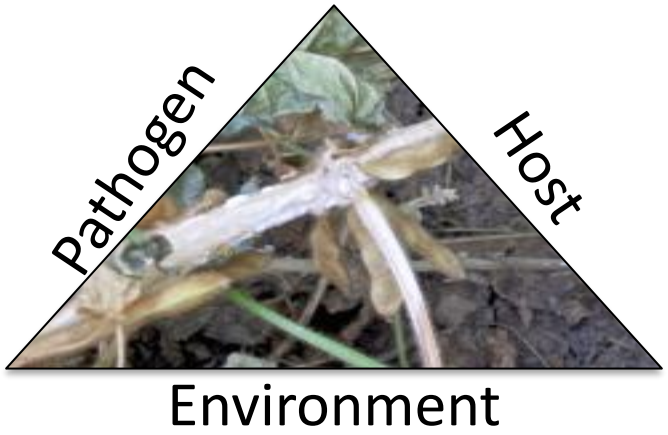
What is a Fungus?

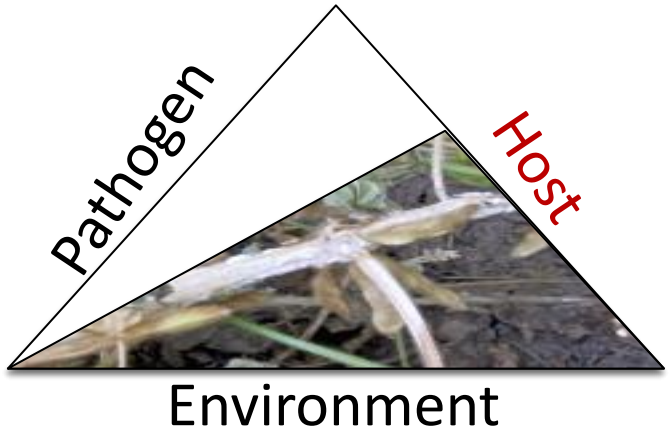
A group of unicellular, multicellular, or syncytial spore-producing **organisms feeding on organic matter due to the lack of chlorophyll**

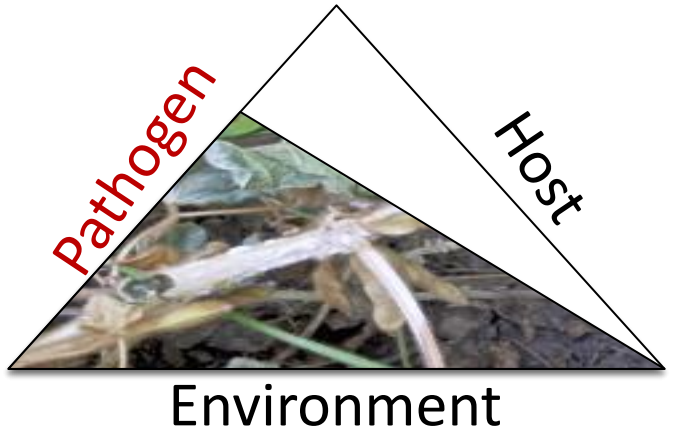
Attack crops **above and below soil** surface

Spread by wind, rain, insects, birds, machinery and contaminated seed

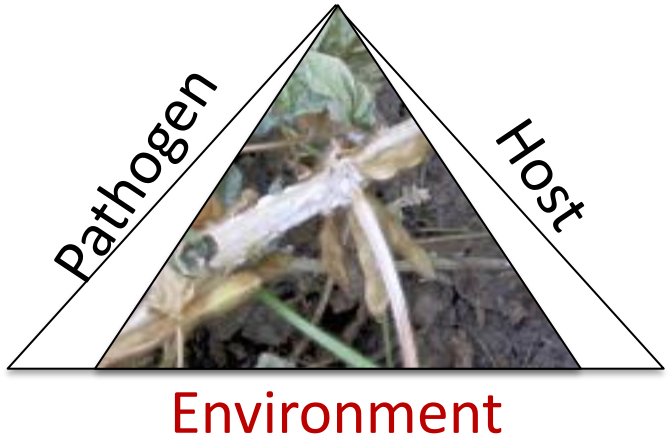
Plant Disease Triangle

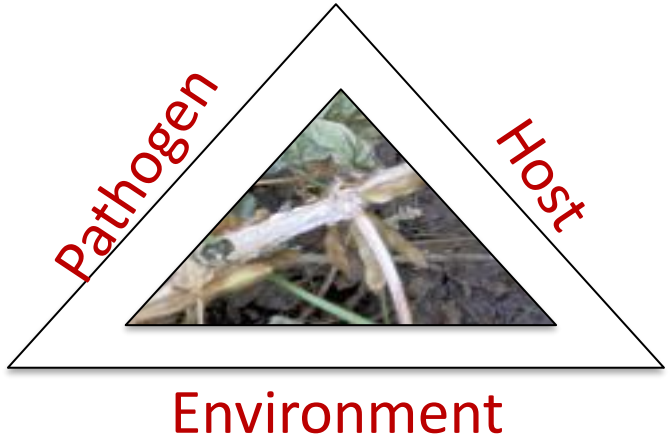






- Disease only occurs if three things exist all at the same time
  - -Pathogen
  - -Host
  - -Environment
- Manipulating a component or combinations of triangle components influences the incidence and severity of disease





Resistance (Genetic)

The prevention or **slowing down of a successful infection by the pathogen in the host**. The parasite coexists with the host.

Most economically-efficient and environmentally friendly way to control disease

Highly desirable and ideal; may be difficult to find

In the pathogen, pathogenicity factors such as toxins, enzymes, hormones, etc, are under genetic control

In the host, susceptibility/resistance is usually controlled by the genetics of the host

Protection (Chemical)

Prevention of infection and establishment of a pathogen in a susceptible host.

The pathogen coexists in the area with the host; contact between pathogen and host is made.

Protection usually happens before infection.

What is a fungicide and why are they needed?

A fungicide is an agent that destroys fungi or inhibits their growth

Why are they needed?

- **To control** a disease during the establishment and development of a crop
- **To increase** productivity of a crop
- **To improve** the storage life and quality of harvested material

Fungicidal seed treatments

What is their value?

Soybean seedling diseases

Disease	Causal agent	Symptoms	Conditions favoring development	Notes	
Pythium	*Pythium* spp.	Damping off	cool and wet	Resistance to metalaxyl and mefenoxam has been documented.	
Phytophthora	*Phytophthora sojae*	Damping off	cool and wet	Resistant genetics aid in control.	
Rhizoctonia	*Rhizoctonia solani*	Damping off	warm and dry	Usually occurs in early to mid summer.	
Fusarium	*Fusarium* spp.	Damping off	cool and wet	Same genus as SDS.	
Phomopsis	*Diaporthe longicola*	moldy, shrivelled seeds	warm and wet	More of a problem in seed fields.	

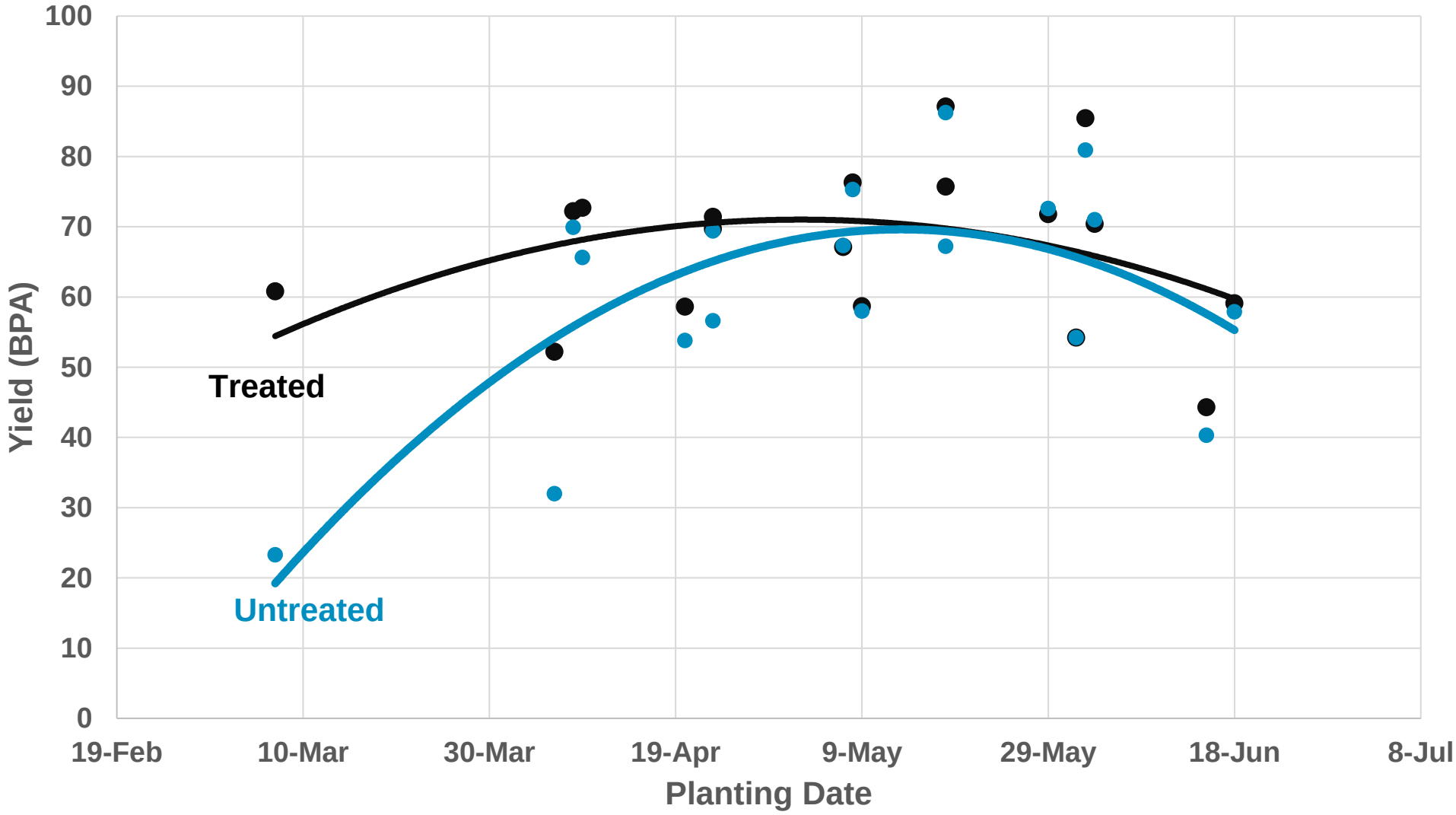
Fungicidal seed treatments

Fungicidal components of Acceleron® seed treatment

Fungicide Active Ingredient	*Pythium*	*Phytophthora*	*Rhizoctonia*	*Fusarium*	Sudden Death Syndrome (SDS)	*Phomopsis*
Azoxystrobin	P-G	N	VG	F-G	N	P
Carboxin	U	U	G	U	N	U
Ethaboxam	E	E	N	N	N	N
Fludioxonil	N	N	G	F-VG	N	G
Fluopyram	N	N	N	N	VG	N
Fluxapyroxad	U	U	E	G	N	G
Ipconazole	P	N	F-G	F-E	N	G
Mefenoxam	E	E	N	N	N	N
Metalaxyl	E	E	N	N	N	N
Oxathiapiprolin	P-G	E	N	N	N	N
PCNB	N	N	G	U	N	G
Penflufen	N	N	G	G	N	G
Prothioconazole	N	N	G	G	N	G
Pyraclostrobin	P-G	N	F-G	F	N	G
Sedaxane	N	N	E	N	N	G
Thiabendazole	N	N	N	N	P	G
Trifloxystrobin	P	P	F-E	F-G	N	P-F

Source: University of Illinois (2019) http://cropdisease.cropsciences.illinois.edu/wp-content/uploads/2019/06/2019-Soybean-Seed-Treatment-Fungicide-Efficacy-Table_final.pdf

Yield performance of treated vs. untreated seed 2019-2020



Acceleron® Standard vs untreated at Roanoke, IL and Newark, IL

Foliar Fungicide Treatments

- **Benefits**
- **Choosing the correct product**
- **Timing**
- **Application method**

Fungicides are Important Agronomic Tools

- **Value of fungicides** has been proven
- Many of the popular varieties, hybrids, and cultivars with the most yield potential respond dramatically to fungicide applications
- Higher plant populations **– denser canopy**
- Reduced tillage – more **crop residue**
- **Increase ROI** on increasingly expensive inputs
- Even so, still many **untreated acres that would benefit from a fungicide treatment**

Contact vs. Systemic Fungicides

Contact/Protectant

- Adsorbed
- Immobile
- Preventive
- Multi site of action
- Few problems with resistance

Systemic

- Absorbed
- Mobile
- Preventive + Curative
- Single site of action
- Resistant fungi strains could develop

Fungicide classes used as foliar fungicides for field crop production

Quinone outside inhibitors (QoIs; strobilurins)	11
Demethylation inhibitors (DMIs; triazoles)	3
Succinate dehydrogenase inhibitors (SDHIs)	7

QoI fungicides (FRAC Code 11)

11

QoI = quinone outside inhibitor

Strobilurin fungicides are in this group:

- Azoxystrobin (Quadris®; 1 a.i. in Quilt Xcel®)
- Pyraclostrobin (Headline®; 1 a.i. in Headline AMP®)
- Trifloxystrobin (Gem® and Flint®; 1 a.i. in Stratego® YLD, Delaro®, and Delaro® Complete)
- Fluoxastrobin (Evito®)
- Picoxystrobin (Aproach®)

Work best when applied <u>preventatively</u>

- Very good activity on germinating spores

Some things strobilurins do

Broad spectrum fungal activity

Interfere with mitochondrial electron transport

Primarily inhibit spore germination

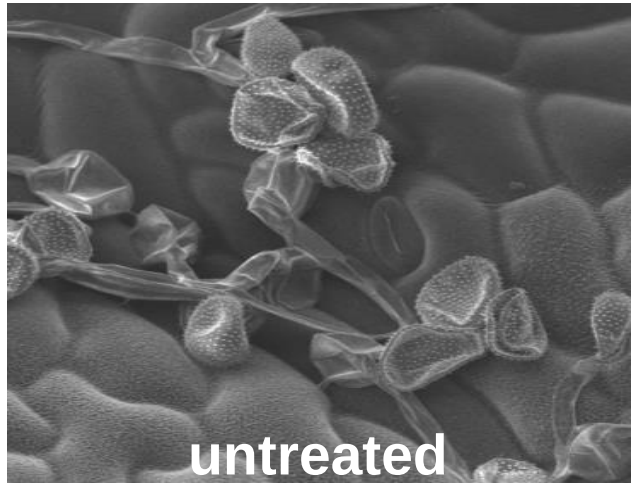
Preventive with very limited curative activity

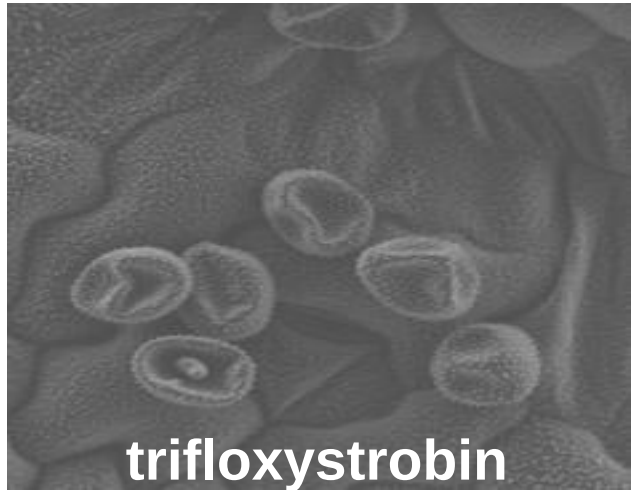
Trigger physiological reactions in the plant

- // Inhibit ethylene production, slowing stress reactions
- // Promote lignification of cell walls
- // Improve utilization of limited resources

Promote yield increases, even without diseases

Prone to resistance development





Electron micrographs of Asian Soybean Rust in plant tissue

Effect of strobilurin on moisture stress tolerance of soybeans

1 well-watered

2 restricted water supply
4 days of
severe moisture stress

3 restricted water supply + Stratego® YLD

Example: Stratego® YLD improves the moisture stress tolerance of soybeans

DMI fungicides (FRAC 3)

3

DMI = demethylation inhibitors

Preventative, Curative, Protective, Penetrant

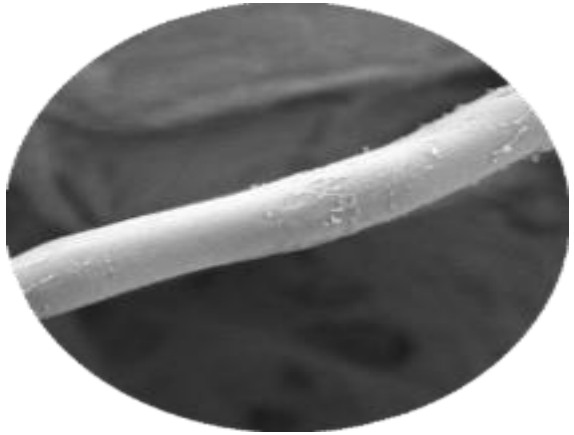
Includes the triazole fungicides:

- Prothioconazole (Proline®; a.i. Stratego® YLD/Delaro®)
- Tebuconazole (Folicur®, multiple generics)
- Propiconazole (Tilt®; a.i. Quilt®/Trivapro®)
- Metconazole (Caramba®; a.i. Headline® AMP)
- Tetraconazole (Domark®)
- Flutriafol (Topguard®; a.i. Fortix®)
- Cyproconazole (Alto®; a.i. Aproach® Prima)

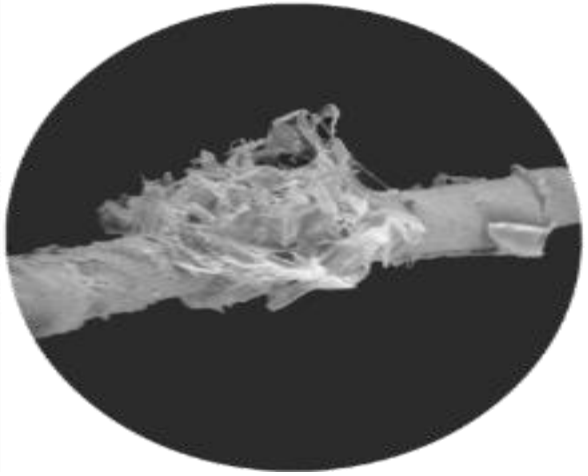
Some things triazoles do

3

- **Broad spectrum** fungal activity
- Interferes with **sterol production**
- Primarily **disrupts membrane production**
- **Preventive and curative activity**
- Can also trigger physiological reactions
- Yield increases mostly related to **disease control**
- **Moderate risk of resistance** development
  - // Higher rates can compensate
  - // Population shifts to normal sensitivity distribution when triazole use discontinues



untreated



prothioconazole

Succinate Dehydrogenase Inhibitors (SDHIs) (FRAC Code 7)

7

SDHI = Succinate Dehydrogenase Inhibitors

- **Preventative, w/ some Curative**

Includes the SDHIs fungicides:

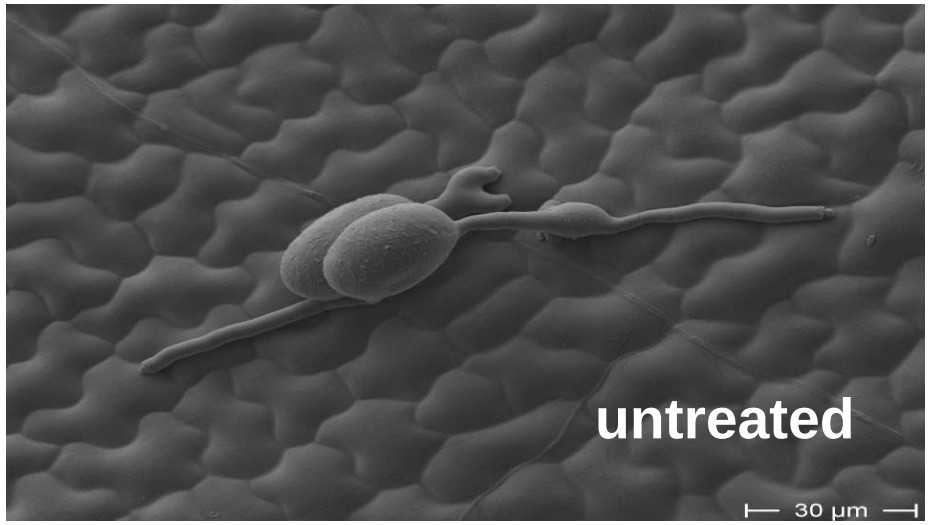
- Boscalid (Endura®)
- Fluxapyroxad (a.i. Priaxor®)
- Bensovindiflupyr (Solatenol®; a.i. Trivapro®)
- Fluopyram (Luna®, Propulse®, Delaro® Complete)

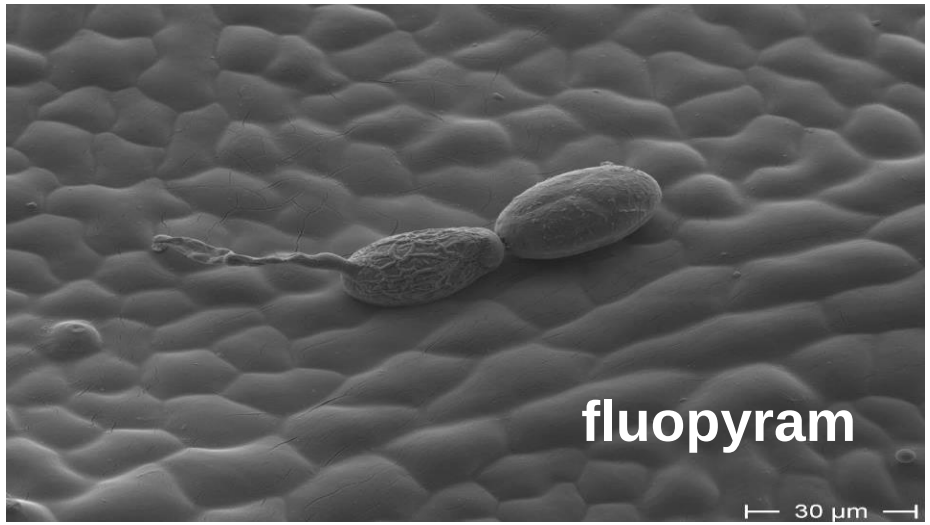
Have locally systemic to systemic properties through the xylem

Inhibit fungal respiration

Some things SDHI's do

- High specific activity on selected pathogens, chemistry dependent
- Interferes with energy production
- Primarily preventive with some curative activity on surface infections
- High risk of resistance development





Importance of Multiple Modes of Action

Broaden performance

- Combine strengths
- Increase consistency across weather conditions

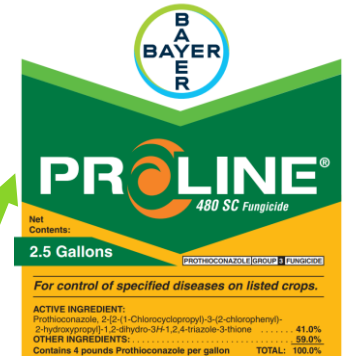
Attack the fungi in multiple ways

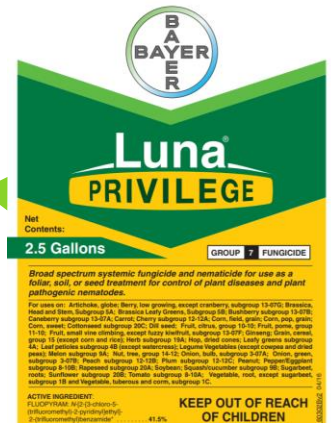
- e. g., strobilurins and SDHI’s inhibit respiration (spore germination), while triazoles affect sterol biosynthesis (membrane production)
- Both preventive and curative is good

Critical for resistance management

- More than one must have activity on pathogens
- Mixtures are better than solos

What does an active ingredient actually contribute?





What do the products do on their own?

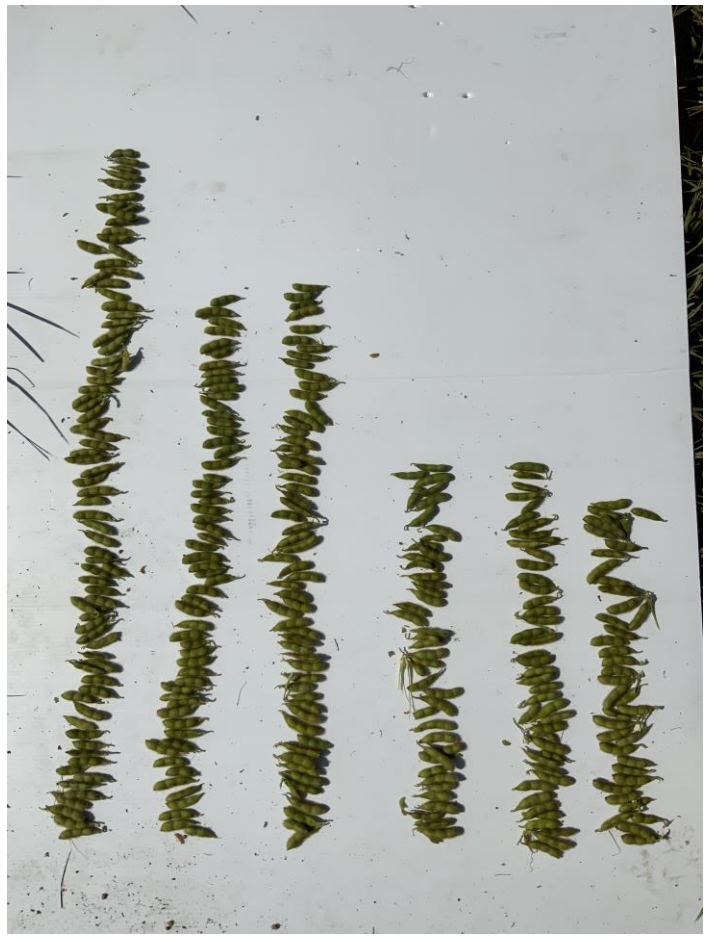
- Proline (Triazole/DMI):
  - White Mold
  - Rust
  - Seportia (Brown Spot)
  - Cercospora (FLS)
- Flint (strobi):
  - Cercospora (FLS)
  - Rust
  - Fusarium
- Luna Privilege (SDHI)
  - Cercospora (FLS)
  - Septoria (Brown Spot)
  - White Mold

Fungicide applications protect yield potential by helping soybeans manage stress.

Wayne County Soybean Side by Side

Wayne County Soybean Side by Side

Treated vs. untreated



Treated vs. untreated


Untreated
Delaro +
Leverage 360

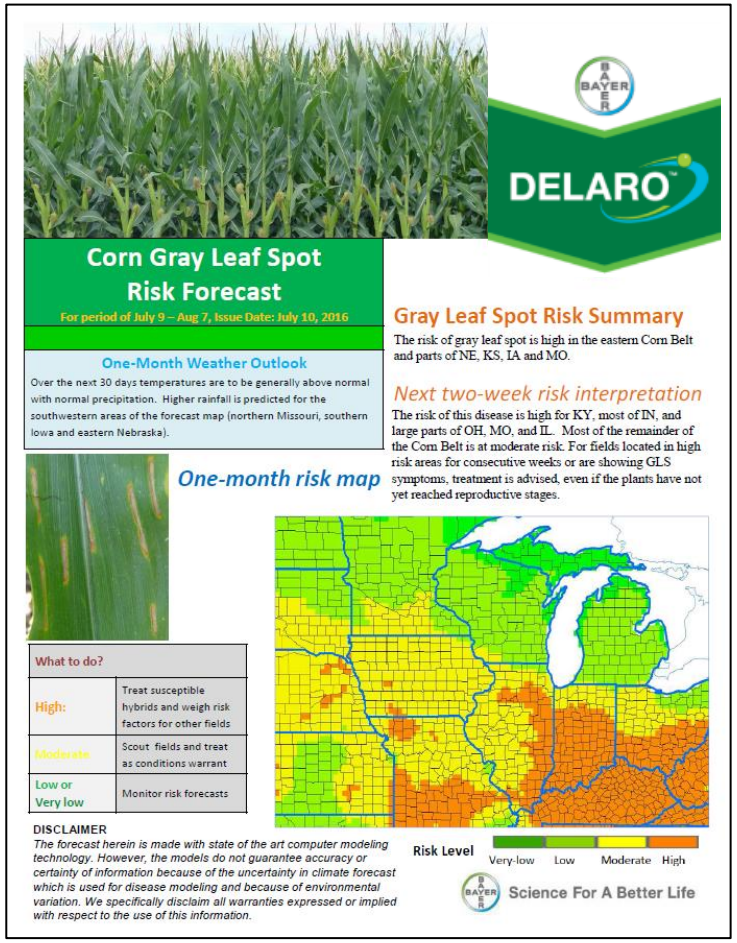
How do I know whether or not to spray?

Fungicide Spray Checklist

- Frequent rainfall, dew and humidity (free moisture on leaf surface for 10+ hours)
- Crop rotation (corn-on-corn, soybean-on-soybean)
- Reduced or no-till practices
- Late planting date (more important in corn)
- Disease-susceptible hybrid / variety
- Field subjected to stress (hail, dryness, etc.)
- Early evidence of diseases in the field
- History of disease or lodging issues in the field
- Grain sold for seed or premium market

The more criteria met, the more likely you will see a yield bump.

Weekly Disease Forecast



Timing and method of fungicide application

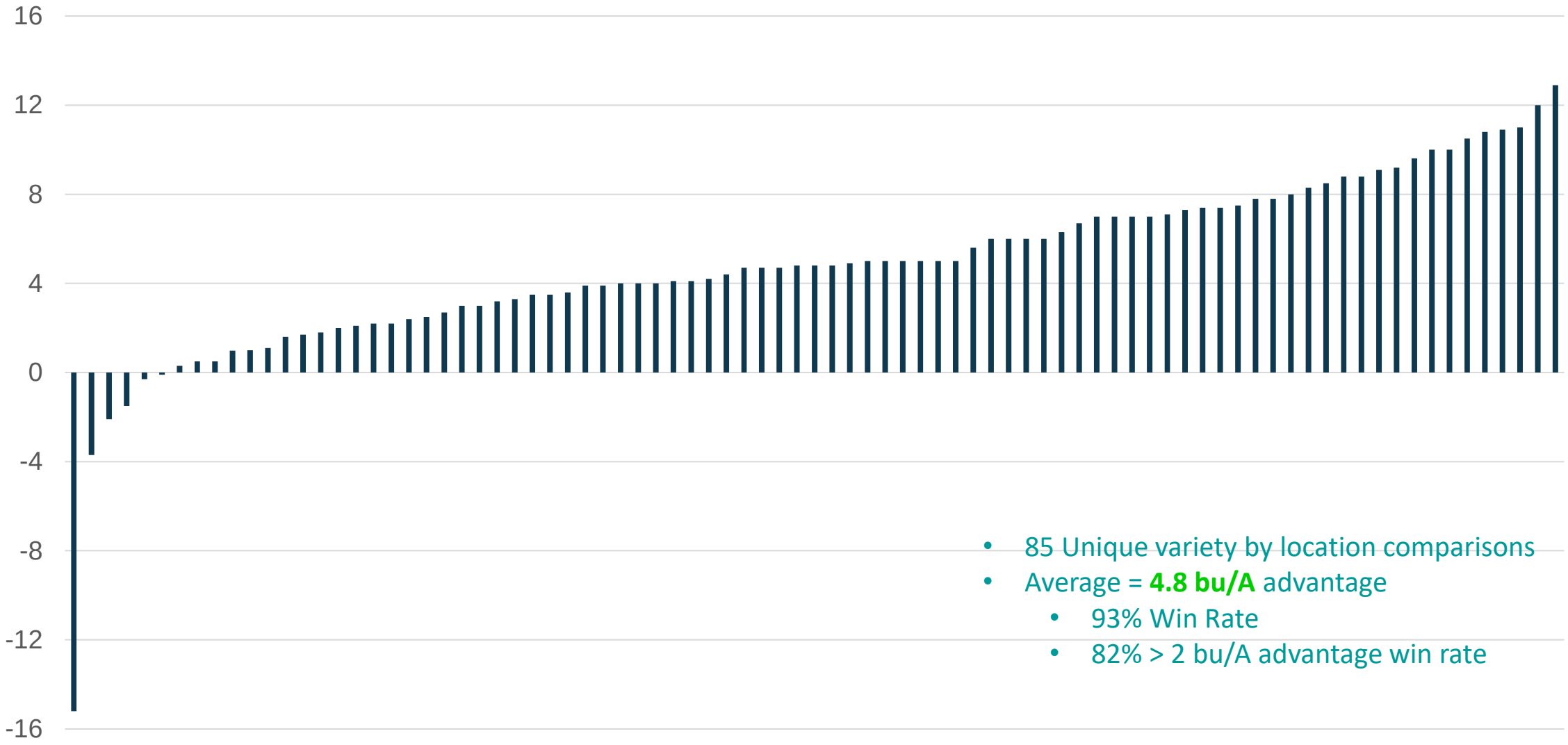
- In general, soybeans should be sprayed R2-R4.
  - Normally a wide window in which we see a yield response.
  - Exception for certain diseases such as White Mold.
- Better efficacy in conditions of higher humidity.
  - Mid-day can have higher evaporation = less absorption.
- Our research shows similar responses to aerial and ground application.

Local research

Results from local FOCUS site trials

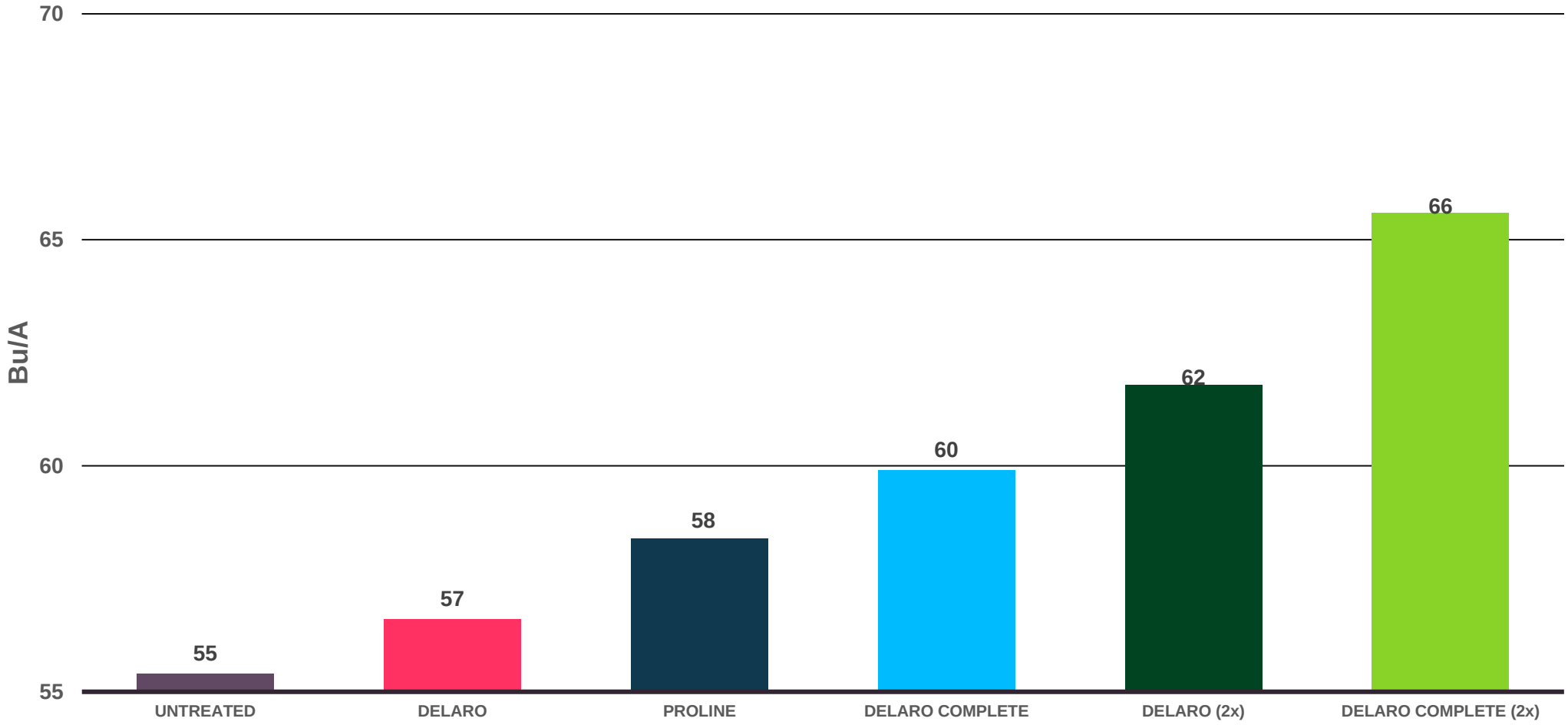
DELARO® Complete

2020 Delaro® Complete vs Untreated on Soybean



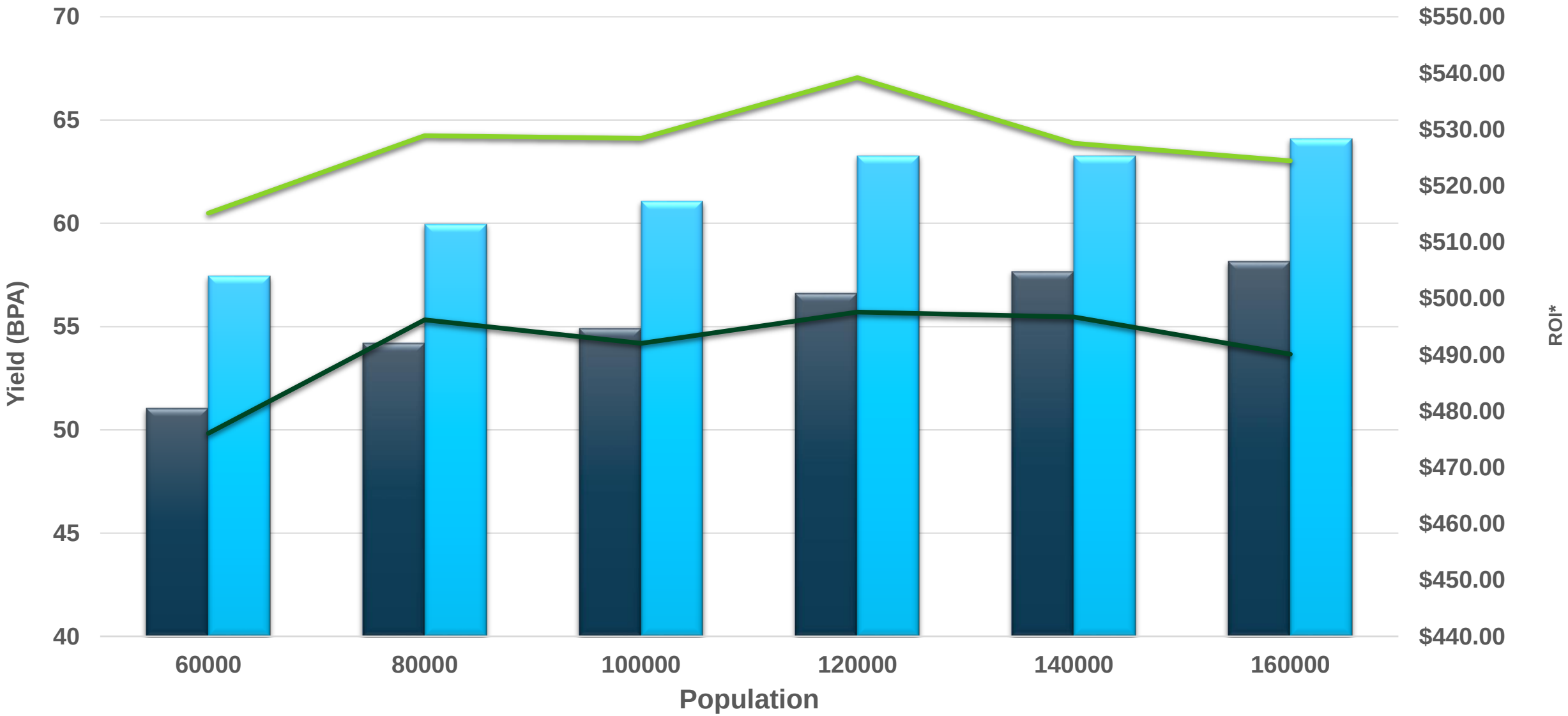
- 85 Unique variety by location comparisons
- Average = **4.8 bu/A** advantage
  - 93% Win Rate
  - 82% > 2 bu/A advantage win rate

2019 Yield response to fungicide in fields with heavy white mold pressure



Data represented within this page were derived from Bayer internal small plat trials across Midwestern states.

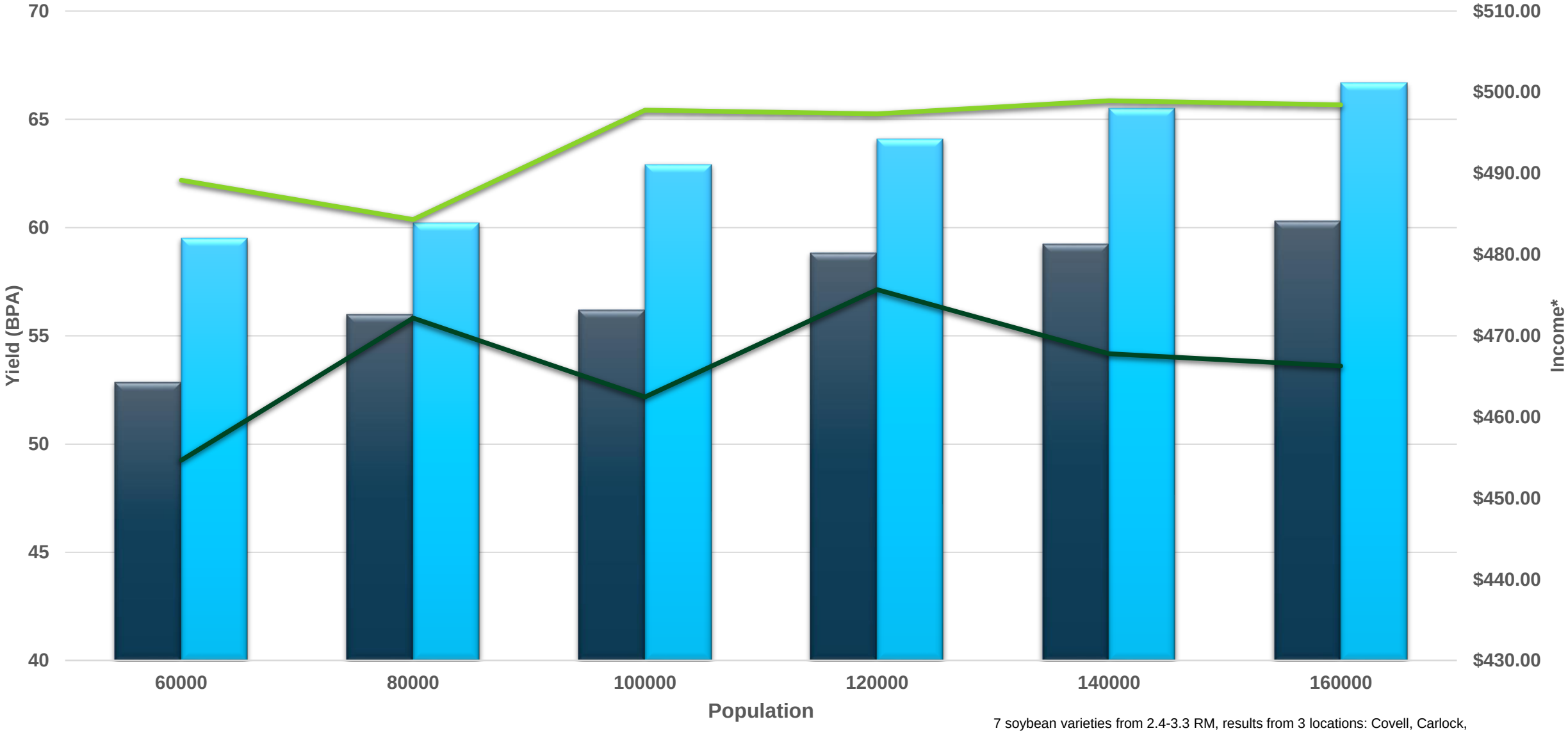
Soybean yield response to fungicide and variable population 2019-2020



26 soybean varieties from 2.2-3.9 RM, results from 7 site years in central and northern Illinois.

* Assumes seed cost of $80/unit, application cost of $25/acre, and grain value of $10/bushel

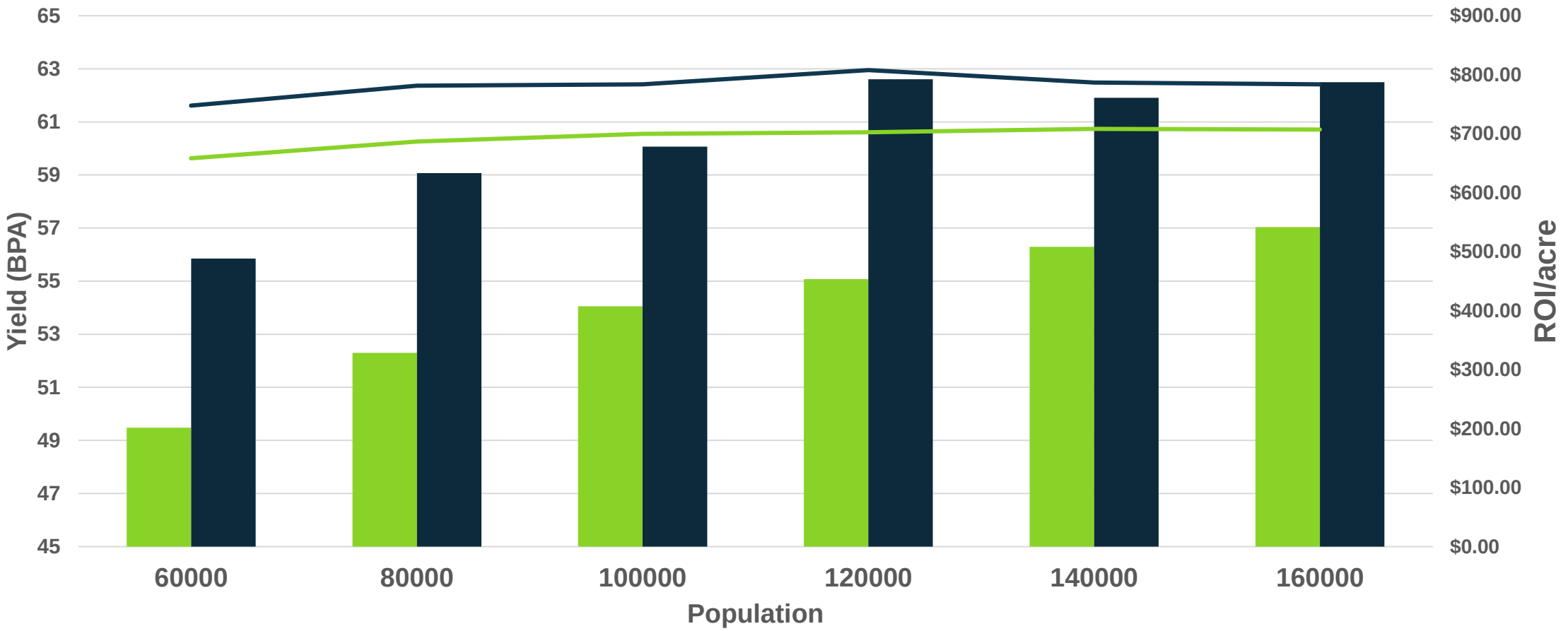
Soybean yield response to fungicide and variable population in 2019



7 soybean varieties from 2.4-3.3 RM, results from 3 locations: Covell, Carlock, and Roanoke, IL planted May 20- June 4.

* Assumes seed cost of $80/ unit, and grain value of $9.25/acre

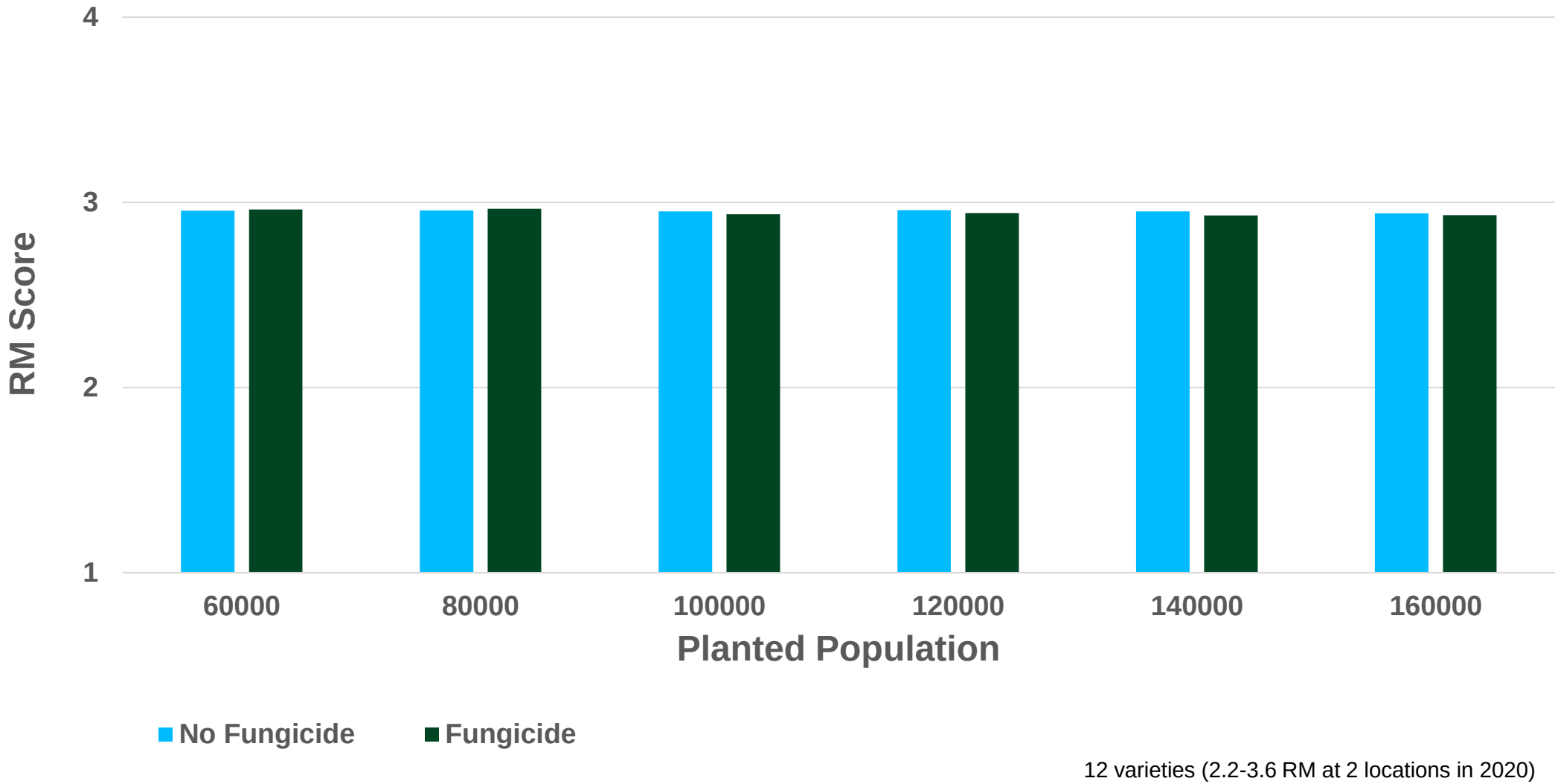
Soybean yield response to fungicide and variable population in 2020



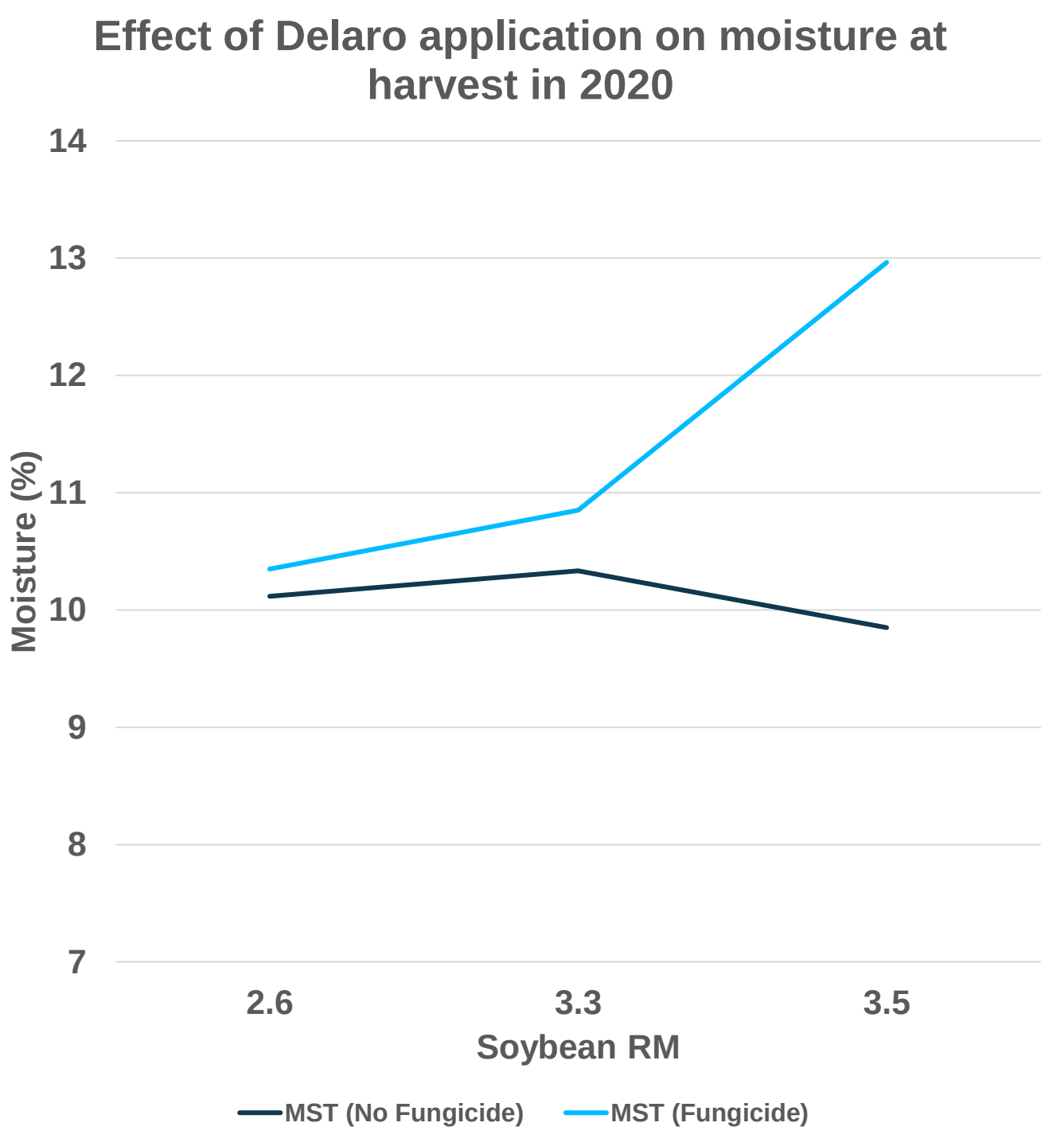
ROI calculation based on seed cost of $80/ unit, fungicide $25/ acre, and soybean value of $10/ bushel

12 varieties (2.2-3.6 RM) across 4 locations (Covell, Danvers, Roanoke, Newark) – small plots

Fungicide effect on maturity in variable populations in 2020



12 varieties (2.2-3.6 RM at 2 locations in 2020)


Effect of Delaro application on moisture at harvest in 2020
14
13
12
11
10
9
8
7
Moisture (%)
2.6
3.3
3.5
Soybean RM
MST (No Fungicide)
MST (Fungicide)

Thank you!

Questions?