A history of use and success:

2000 B.C. to 100 A.C.  First soaking techniques: use of sap of onion or cypress (Egypt, Greece, Roman Empire)

Middle Ages  Soaking in chlorine salts and manure

1600’s  Soaking in salt water

Mid-1700’s  Introduction of copper salts

1740  Introduction of arsenic

1765  Soaking in hot water (Germany)

1808  Ban of arsenic

1915  Introduction of organo-mercurics

1960’s  Introduction of first systemic fungicide

1970’s  First systemic fungicide against air-borne pathogens

1982  Ban of organo-mercurics in Western Europe

1990’s  Introduction of new modern fungicides and insecticides
Objective:

Achieve control of plant disease and insects with improved crop and applicator / farmer safety.

Properties include:

“long lasting”   systemic
broad spectrum   user-safety
reduced rate     effective
Seed treatments and IPM

How do you decide:

Core Principles of IPM

• **Identify** and **Monitor** Pests
• **Preventive** management
• **Action Thresholds** / economics
• Appropriate **control** measures
What will be discussed

• Fungicides
• Insecticides
• Nematocides

What won’t be discussed

• Rhizobia Inoculants
• Seed applied fertilizers
Soybean seed treatments - Conclusions

- Seed treatments can reduce stand loss from fungi but require special circumstances to provide a yield response.
- Insecticides can provide **early season** control of PLH, BLB and SBA, but are they necessary.
- Current nematicides options do not reduce SCN populations.
- Treated seed cannot be sold as grain
- A pest control cost is locked in at planting regardless of pest populations
Why USE a seed treatment?

- Cannot repair stand loss (or insect damage) after it occurs
- Minimal effort to control disease, insect or nematode
- Relatively inexpensive insurance
- May compliment host plant resistance
Why NOT use a seed treatment?

• Expense that could be applied elsewhere in the operation.
• Potential for resistance development
  – Soybean aphid
• Poor predictability of return
• Unused seed disposal
  – Treating close to planting reduces risk relative maturity issues.
Soybean Seed Treatment Fungicides

- **Surface fungicides**
  - captan
  - fludioxonil (Maxim)
  - thiram

- **Systemic fungicides**
  - azoxystrobin (Dynasty)
  - Ipconazole (Rancona)
  - Trifloxystrobin (Trilex)
  - carboxin (Vitavax)
  - metalaxyl (Allegiance)
  - mefenoxam (Apron XL)
  - thiabendazole (TBZ)

**Biological fungicides**
- *Bacillus subtilis* (Yield shield)
- *Bacillus pumilis* (Kodiak)

*TAKE CONTROL*
Fungicide seed treatment summary (28 site years MN)

• Four years and 28 trials
• Wide range
  - Environments
  - Soil types
• Only six showed significant yield difference
• Only 15/28 trials Apron/Max out- yielded check
• Stand and root ratings not well correlated with yield
## Fungicide seed treatment summary
(28 site years)

<table>
<thead>
<tr>
<th>Year</th>
<th>Apron+Maxim yield &gt; check</th>
<th>Northern MN</th>
<th>Southern MN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>4/6 (2*)</td>
<td>3/3 (2*)</td>
<td>1/3(0)</td>
</tr>
<tr>
<td>2000</td>
<td>4/9 (2*)</td>
<td>2/5 (1*)</td>
<td>2/4(1*)</td>
</tr>
<tr>
<td>2001</td>
<td>3/7 (1*)</td>
<td>2/3 (1*)</td>
<td>1/4(0*)</td>
</tr>
<tr>
<td>2002</td>
<td>4/6 (1*)</td>
<td>2/3 (0*)</td>
<td>2/3(1*)</td>
</tr>
<tr>
<td>total</td>
<td>15/28 (6*)</td>
<td>9/14(4*)</td>
<td>6/14(2*)</td>
</tr>
</tbody>
</table>

* Significant yield differences (0.05 – 0.10) observed 21% of the trials.
Effect of Seed Treatments on North Dakota Soybeans *

Effect of Seed Treatments on North Dakota Soybeans *

2003

2004

* Source: C. A. Bradley, Plant Disease 90:120-125 (2008)
Summary of the effect of fungicide seed treatments on soybean yield in U of Illinois fungicide seed treatment trials conducted from 2005 to 2010.

Source: Bradley The Bulletin. Issue No. 6, May 13, 2011
What’s the problem?

- Limited effective life 7-10 days to?
- Fungicide positional availability
- Seed injury (handling and potentially phyto toxic if wrong rate?)
- **Limited scope of fungicide efficacy (fungal sp. and strains)**
- Limited environmental conditions for disease development
- Soybean stand mortality is not necessarily yield reducing
- An exercise in Chaos mathematics

TAKE CONTROL
There are no guarantees.

2011 soybean fungicide and nematicide seed treatment trial at the SWROC (background). Muddled in, underwater 2x before V3. Untreated check numerically highest yield (N.S.). Yielded 40 bushels with June 3 planting date and this type of stress. (B. Potter, personal communication)
## Spectrum of soybean seed treatment fungicides

<table>
<thead>
<tr>
<th></th>
<th><em>Phytophthora</em></th>
<th><em>Pythium</em></th>
<th><em>Fusarium</em></th>
<th><em>Rhizoctonia</em></th>
<th><em>Phomopsis</em></th>
<th>Rhizobium interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metalaxyl (Acquire, Allegiance)</td>
<td>G/E</td>
<td>G/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mefanoxam (Apron)</td>
<td>G/E</td>
<td>G/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fludioxonil (Maxim)</td>
<td></td>
<td></td>
<td>G/E</td>
<td>G</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Carboxin (Vitavax, Germate)</td>
<td>F</td>
<td></td>
<td>G</td>
<td>G</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Bacillus subtilis (Kodiak)</td>
<td></td>
<td></td>
<td></td>
<td>G</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Captan+PCNB+TBZ (Rival)</td>
<td></td>
<td></td>
<td></td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Azoxystrobin (Dynasty)</td>
<td>F</td>
<td></td>
<td>G</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyraclastrobin (Acceleron)</td>
<td></td>
<td></td>
<td>G</td>
<td></td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Trifloxystrobin (Trlex)</td>
<td>F</td>
<td></td>
<td>G</td>
<td></td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Mefanoxam+Fludioxonil (ApronMaxx)</td>
<td>G</td>
<td></td>
<td>G</td>
<td>G/E</td>
<td>G</td>
<td>G</td>
</tr>
</tbody>
</table>


Efficacy of seed treatment fungicides for agronomic crops in Ohio. Ohio State University Extension Bulletin 639A-01

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**TAKE CONTROL**

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**University of Minnesota** | **extension**

*Driven to Discover™*
Optimal soil temperatures for development of soybean root pathogens

- **Pythium ultimum**
- **Fusarium oxysporum**
- **Fusarium solani f.sp. glycines**
- **Phytophthora sojae**
- **Rhizoctonia solani AG1**
- **Rhizoctonia solani AG41**

Root symptoms:
- Soils > 60 F
- Fusarium solani f.sp. glycines
- Phytophthora sojae
- Rhizoctonia solani AG1
- Rhizoctonia solani AG41
- Pythium ultimum

Foliar symptoms:
- Soils > 60 F
Phytophthora sojae

Life cycle: overwinter in plant debris (oospores), infect direct (spore contact with host) or indirect (zoospore swims to host)

Host: soybean

Environment: poorly drained or flooded soils, temperature above 60°F
Pythium spp.

Life cycle: soil-borne and survive for a long time on decaying plant matter or dormant stage. They infect plants as zoospores

Host: broad host range

Environment: infects when soil is saturated and soil temperature below 60°F
Best chance for a payback?

• Field **history of damping** off problems
• Planting into **cool conditions** (species dependent)?
  Early planting?
  Planting into high residue conditions?
• **Saturated soils** expected within 7-10 days of planting
  Planting into poorly drained soils?
• Fungicide seed treatments can help with seed-borne fungi (**poor quality seed?**) like Phomopsis but not virus (BPMV, SMV)

TAKE CONTROL
Soybean Seed Treatment
Insecticides

- **Surface insecticides**
  - permethrin (Kernal Guard)

- **Systemic insecticides**
  - clothianidin (Poncho®)
  - imidacloroprid (Gaucho®)
  - thiomethoxam (Cruiser®)
Seed applied insecticides
Seed applied insecticides - Effect on SBA and Yield
Croplan CR 1976 planted 5/16/03
U of M - SWROC, Lamberton, MN

- Rival/Allegience (check)
- R/A + Poncho 600@62.5 g/100kg
- R/A + Poncho 600@125 mg/kg
- R/A + Gaucho 480@125 mg/kg
- R/A + Cruiser @ 62.5 mg/kg
- R/A + Warrior @ 0.025 #a/A
- R/A + Baythroid @0.044#a/A
- LSD (p=0.05)

Aphid days X 1000
Bushels/A

Foliar treatments

TAKE CONTROL
A comparison of soybean pest management strategies
Lamberton site 2008
MacRae, Brietenbach, Holen, Ostlie & Potter

Bushels/acre

26.3 32.2 27.9 31.9 43.1 40.4 34.5 44.2 43.0 41.0

Control, Cruiser/Warden, Insecticide V3, Fungicide R3, Insecticide R3, Fungicide R3 + Insecticide R3, Cruiser/Warden + Fungicide R3 + Insecticide R3, JPM (Insecticide ET)

Croplan 2020 RR
Fungicide Headliner @ 6 oz
Insecticide - Warrior II @ 1.6 oz

Lamberton Yields - 2008
A comparison of soybean pest management strategies

Crookston Location

Bushels/acre

- untreated
- Cruiser Max
- Insecticide V3
- Fungicide R3
- Fungicide + Insecticide R3
- Insecticide R3
- Cruiser + Fungicide + Insecticide R3
- IPM (Insecticide @ ET)

Crookston Yields – 2008
Crookston Yields - 2009

- Control: 38.5
- Cruiser Max (AP): 33.6
- Insecticide V3: 36.7
- Fungicide R3: 45.9
- Fungicide & Insecticide R3: 37.3
- Insecticide R3: 46.1
- Cruiser Max (AP) & Fungicide R3: 37.3
- Cruiser Max (AP) & Fungicide R3 & Insecticide R3: 37.5
- Cruiser Max & Insecticide R3: 38.6
- IPM: 46.8
2008 Morris, MN Strip Trial
Soybean Aphid Counts

Soybean aphids/plant

8/7/2008
8/14/2008
8/20/2008

Warrior at ET
Cruiser MAXX + Warrior at ET
Cruiser MAXX alone
Untreated Check

Insecticide Treatment

Source: J. Knodel, NDSU

Planting Date: 25 May
Harvest Date: 4 Oct
Variety: Pioneer 90M60

Morris Aphid counts - 2008
2008 Morris, MN Strip Trial
Soybean Yield

Yield (bu/acre)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warrior at ET</td>
<td>44.2 a</td>
</tr>
<tr>
<td>Cruiser MAXX + Warrior at ET</td>
<td>44.0 a</td>
</tr>
<tr>
<td>Cruiser MAXX alone</td>
<td>37.7 b</td>
</tr>
<tr>
<td>Untreated Check</td>
<td>35.6 b</td>
</tr>
</tbody>
</table>

Source: J. Knodel, NDSU

Insecticide Treatment

Morris Yields - 2008
* Cruiser alone was not as good as a single well-timed spray at ET.
* Cruiser plots needed a foliar treatment under heavy aphid pressure.

Cruiser + Warrior

Cruiser alone
Seed treatments and Bean Leaf Beetle.

Damage from overwintering generation
Bean pod mottle virus (T,B) and fungal infected (L,R) seeds

B. Potter U of M-2002
Height difference perhaps due to BPMV. Early season BLB controlled in plot at right. U of MN SWROC - Lamberton, MN 2002
Effect of seed treatment on BLB damage and virus incidence
B. Potter U of M (Preliminary)
Damage rated 6/14/02, Virus rated 7/16/02

B. Potter U of M-2002

TAKE CONTROL
Payback for insecticide seed treatments

- Soybean aphid
  - Still require scouting unless grower does not mind less than optimum yield
  - This could change if soybean virus increase
  - Relationship of seed treatments and SBA resistant soybeans is being studied

- BLB
  Inability for early season scouting
  When bean pod mottle virus concern
  - High BLB populations
  - Virus prevalent in area
  - Seed production
Soybean Seed Treatment
Nematicicides

- **Biologicals**
  
  *Bacillus firmus* (VOTiVO®)

- **Systemic nematicicides**
  - amabectin (Activa®)
The effect of soybean seed applied fungicides, nematicides and insecticides on soybean yield where an Hg 2,5,7 SCN population occurs.

U of M SWROC - Lamberton, MN

Treatments

\[ F = (\text{Trilex} + \text{Allegience}) \]
\[ B = F + \text{Gaucho} ; \quad F + \text{Gaucho} + \text{VoTiVo} \]
\[ B2 = F + \text{Poncho} + \text{VoTiVo} \]
\[ S = F + \text{Cruiser} ; \quad F + \text{Cruiser} + \text{Avicta} \]

Note: PI 887888 SCN resistant soybeans used in study
Nematicide seed treatments

• Current products may be beneficial in some situations but not on endoparasitic SCN
• Be careful interpreting results as additional fungicide and insecticide is a component of these treatments as well.
thank you

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