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EXTENSION



Michigan Soybean
Promotion Committee
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Integrated Management of White Mold and the Use of Foliar Fungicides

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Sclerotinia stem rot (white mold)


- *Sclerotinia sclerotiorum*

- Not to be confused with another disease observed in the southern U.S. sometimes referred to as white mold – aka southern blight, caused by *Sclerotium rolfsii*


- Causes “bleached”, shredded stems....the fungus itself can be observed as a white, cottony mold....also may produce sclerotia which are small, hard, black objects



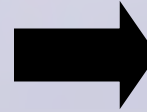
Initial leaf wilt - generally the first symptom observed

A close-up photograph of a plant stem at the soil level. The stem is green and has several long, green, bean-like seed pods attached to it. The base of the stem, where it meets the soil, is covered in a white, fuzzy, cottony mold. A blue arrow points from a text box to this moldy area. The surrounding soil is dark brown and contains some dried, brown leaves and plant matter. Other green leaves of the plant are visible in the background and foreground.

White, cottony mold on base of stem



Sclerotia forming on plant. Eventually, plant tissue will become "bleached" and shredded.



Sclerotia

Mueller



Apothecia

Venette

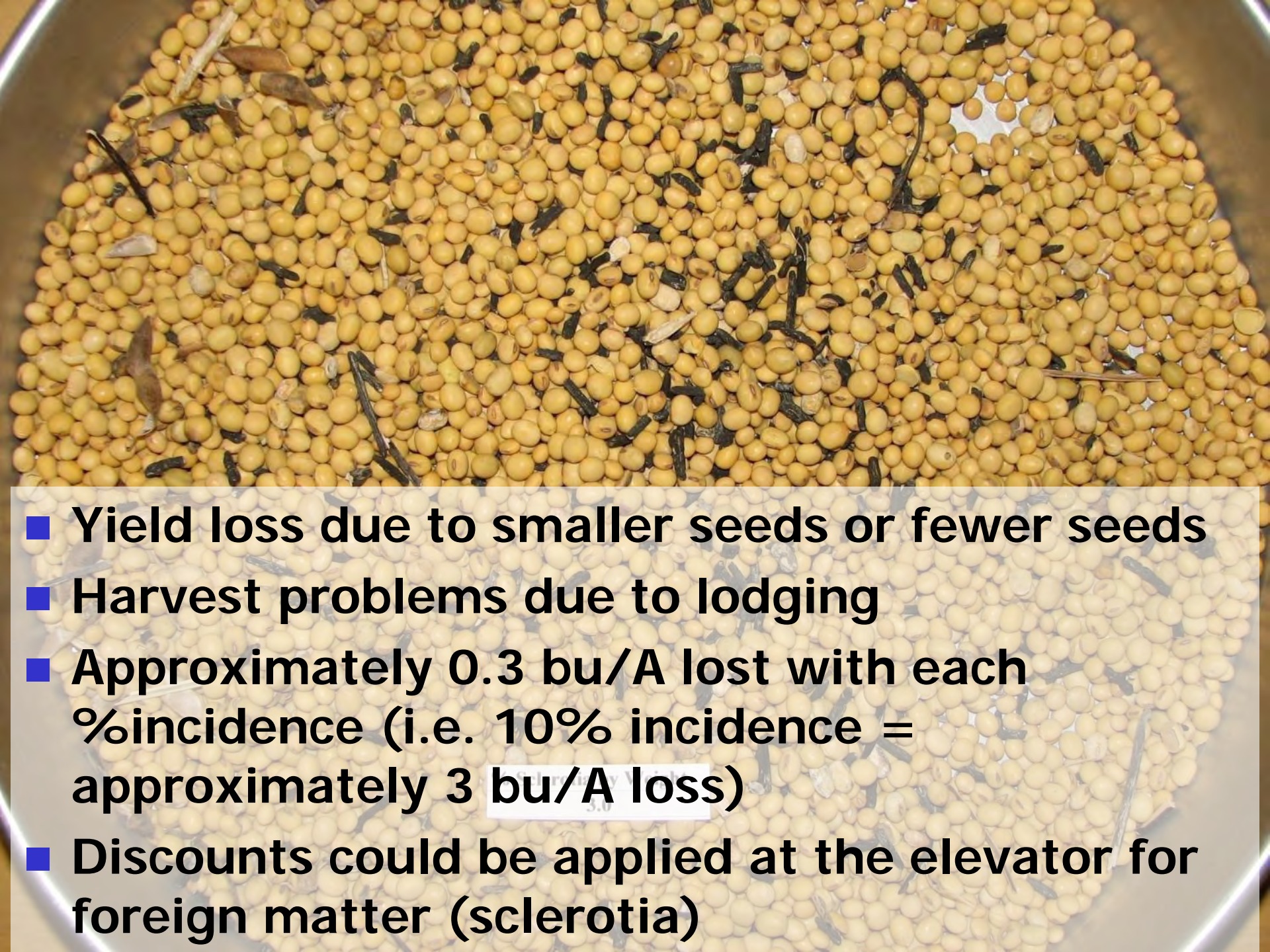


**Ascospores
land on petals**



**Ascospores use
dying petals for
energy source**

**White Mold
Disease Cycle**



- Yield loss due to smaller seeds or fewer seeds
- Harvest problems due to lodging
- Approximately 0.3 bu/A lost with each %incidence (i.e. 10% incidence = approximately 3 bu/A loss)
- Discounts could be applied at the elevator for foreign matter (sclerotia)

Why was white mold such a problem in 2014?



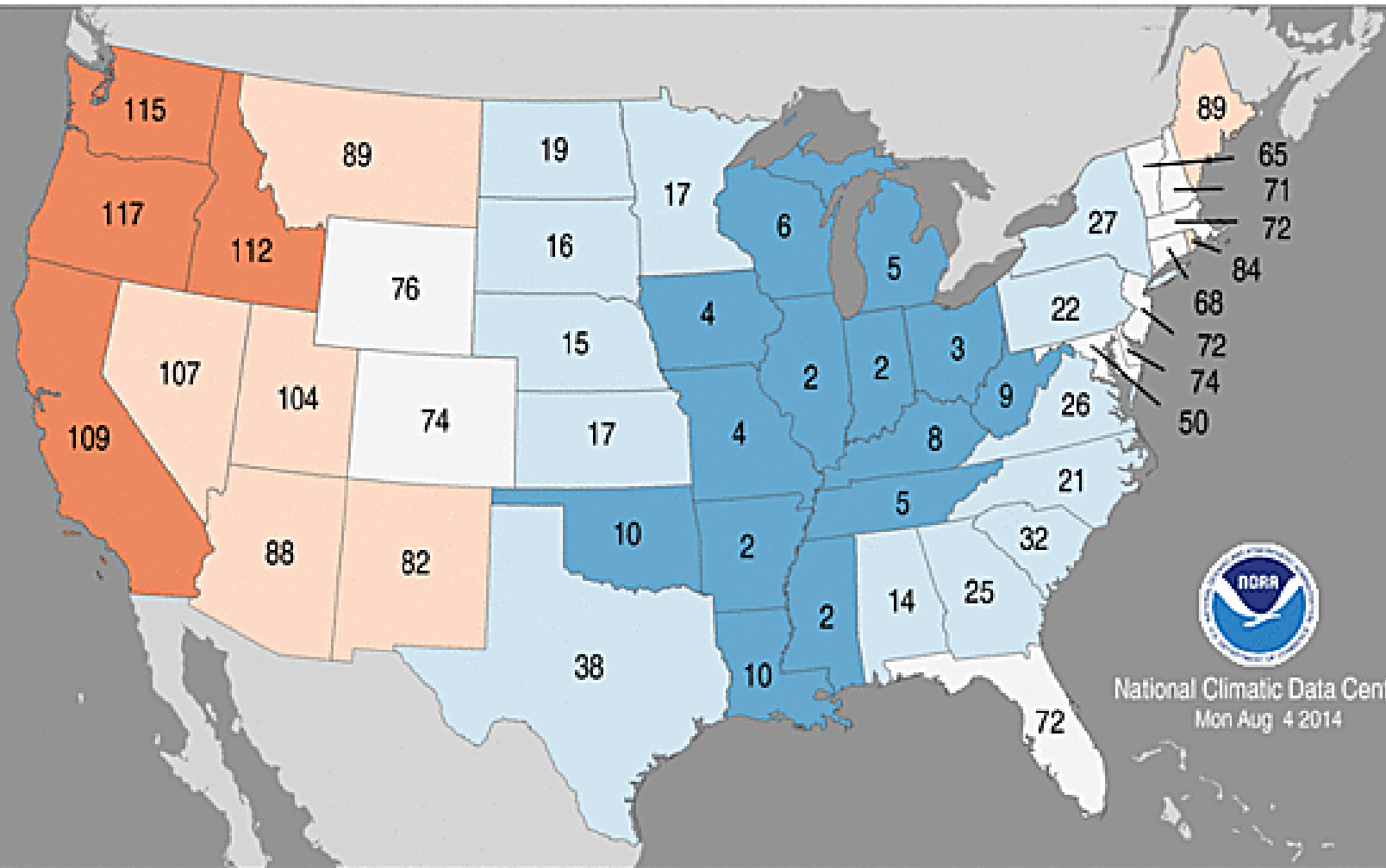
Adjusted to 1bu/A

Photo courtesy: Martin Nagelkirk

Statewide Maximum Temperature Ranks

July 2014

Period: 1895-2014

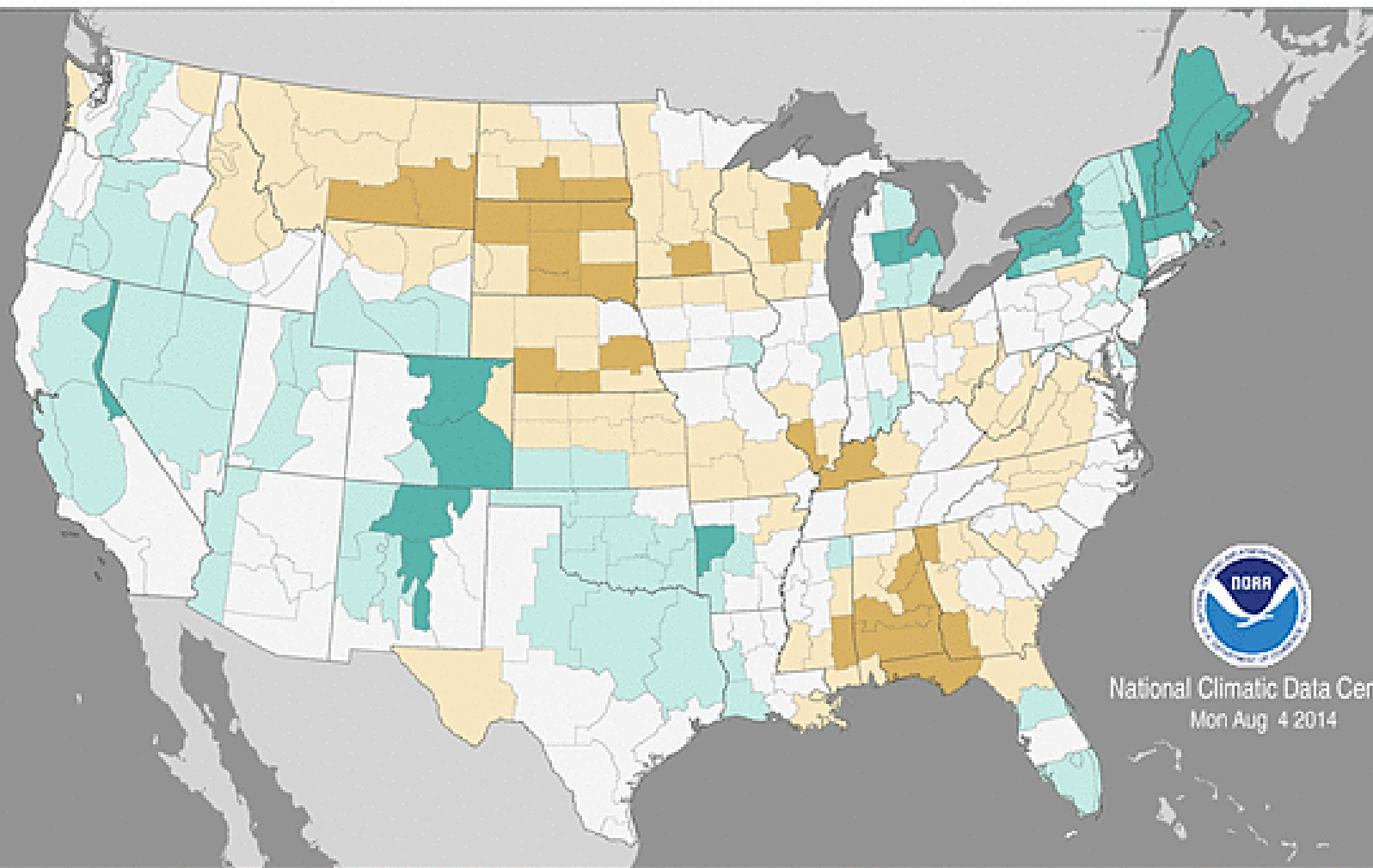


National Climatic Data Center
Mon Aug 4 2014

Divisional Precipitation Ranks

July 2014

Period: 1895-2014



National Climatic Data Center
Mon Aug 4 2014

Record
Driest

Much
Below
Average

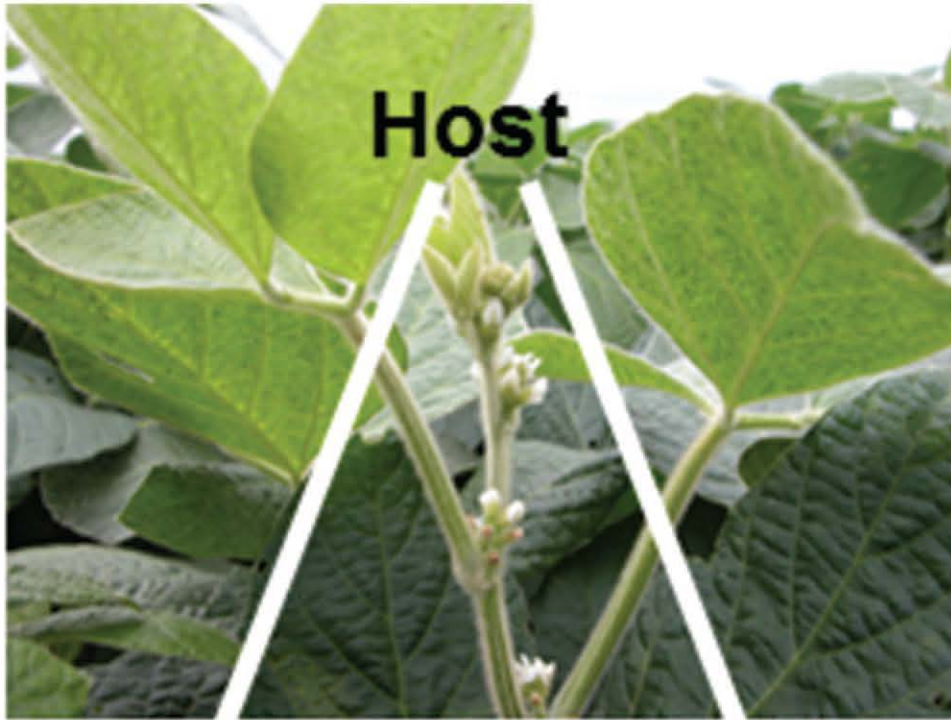
Below
Average

Near
Average

Above
Average

Much
Above
Average

Record
Wettest



Environment is
generally the driver,
and what we have
the least control of!



Environment

"I've not seen this disease in 15 years, where did it come from?"

- Sclerotia can survive for a long time in the soil
- *Sclerotinia sclerotiorum* has a host range of over 400 plant species (including weeds)
 - Fungus may have been surviving on weeds (esp. winter annuals) and not been noticed
- The Plant Disease Triangle Works!
 - Cooler than normal and wetter than normal weather was the driver

Risk Factors for White Mold

- Keep the disease triangle in mind!
 - Environment = cool and wet prior to and throughout flowering
 - Environment = Narrow rows pose a higher risk because of the micro-climate (quicker canopy, more moisture inside canopy)
 - Pathogen = Has white mold ever been a problem in the field before?
 - Host = How does the variety compare to others for resistance to white mold?

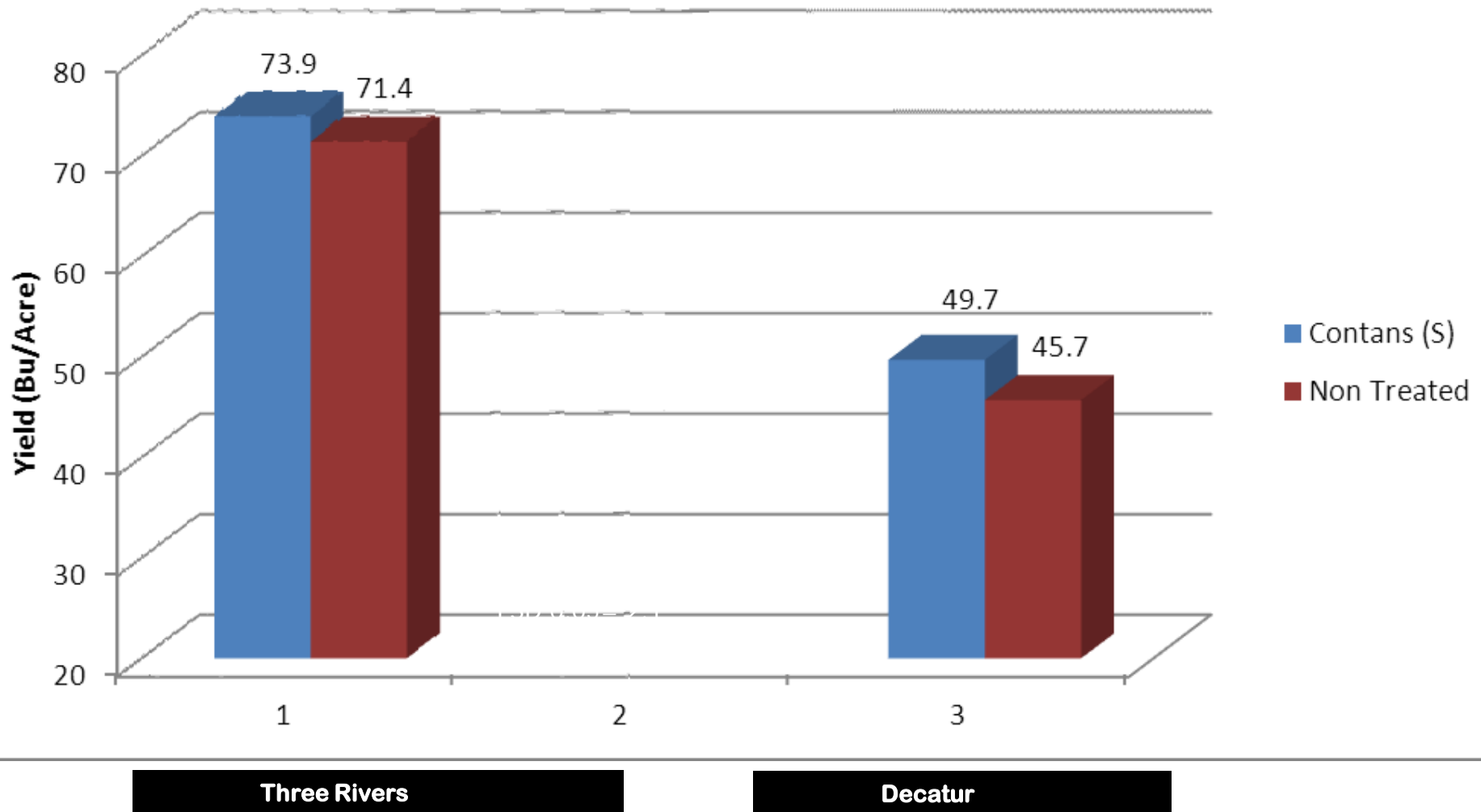
Management of White Mold in Soybean

- No silver bullets – must integrate several management practices:
 - Partially-resistant varieties
 - MSU variety trials www.varietytrials.msu.edu
 - Row spacing and seeding population rates

Management of White Mold in Soybean

- Contans = biological control product
 - Product that contains a fungus (*Coniothyrium minitans*) that can parasitize sclerotia in the soil
 - If high levels of sclerotia in the soil, do not expect big results the first year

2011 yield response to Contans



Foliar fungicides

- Foliar fungicides – only a few registered for white mold control in soybean
- Herbicides – Cobra and Phoenix (lactofen)
- University of IL Fungicide Trials
 - Evaluated timing of Topsin M (2000-01)
 - Evaluated several fungicides (2009-14)

Illinois (Urbana) Topsin M Timing Trial

Year	Treatment	% Incidence	Yield
2000	Untreated	42 a	56 b
	Topsin M @ R1	3 b	73 a
	Topsin M @ R3	36 a	59 b
2001	Untreated	49 a	41 b
	Topsin M @ R1	15 b	51 a
	Topsin M @ R3	50 a	45 ab

Note: The white mold fungus was inoculated onto plants at the R2 growth stage in this trial.

From: Mueller et al. 2004. Crop Protection 23:983-988.

Mist-irrigation system at DeKalb, IL



2009 – DeKalb, IL White Mold Fungicide Trial

Treatment	Incidence (%) 8-11-09	Incidence (%) 9-14-09	DSI (0-100) 9-14-09	Yield (bu/A)
Untreated	75	95	77	24
Topsin M 4.5 FL @ 20 fl oz	43	96	78	24
Omega @ 0.75 pt	35	83	47	32
Omega @ 1 pt	23	80	45	34
Proline @ 3 fl oz	38	95	70	24
Headline 6 fl oz	73	100	84	22
Domark 5 fl oz	68	98	70	23
Cobra @ 12.5 fl oz	15	51	13	42
Endura @ 8 oz (2x)	38	86	45	39
Aproach @ 8 oz (2x)	35	80	37	40
LSD 0.05	33	15	20	8

All sprayed at R1 (July 20), and those with “(2x)” were sprayed again 9 days later. Inoculated with white mold on July 21. DSI = disease severity index.

DeKalb Co., IL Fungicide Trial - 2009



Untreated on 9/14/09

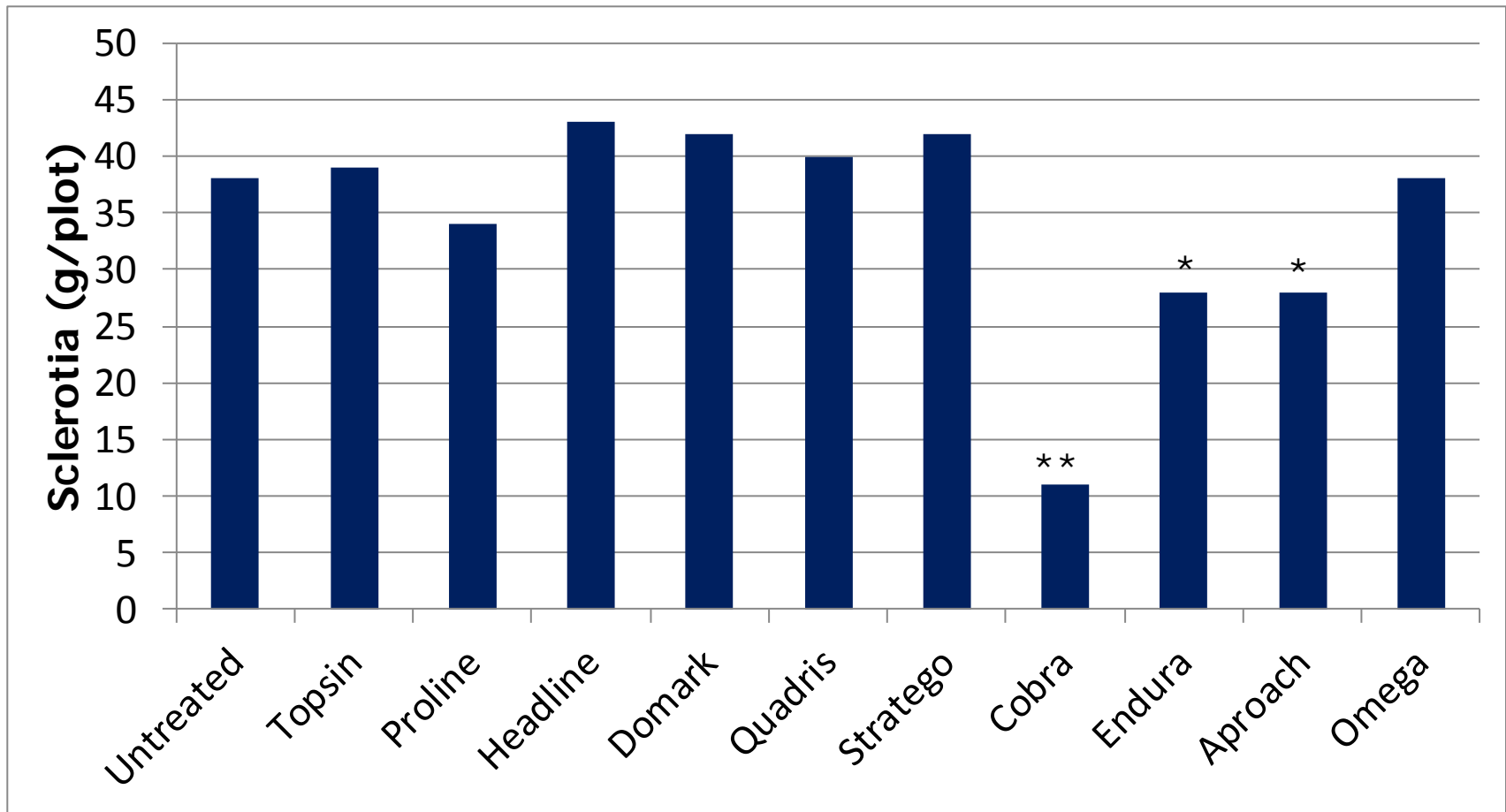


Cobra on 9/14/09



2009 – DeKalb White Mold Fungicide Trial

sclerotia mixed with harvested seed



2010 – DeKalb, IL White Mold Fungicide Trial

Treatment	Incidence (%) 8-26-10	Incidence (%) 9-21-10	DSI (0-100) 9-21-10	Yield (bu/A)
Untreated	18	95	67	62
Endura @ 8 oz	4	79	42	69
Domark @ 5 fl oz	7	76	42	63
Omega @ 0.75 pt	13	86	57	61
Omega @ 1 pt	2	70	29	58
Proline @ 3 fl oz	11	93	60	64
Cobra @ 6 fl oz	6	86	45	56
Cobra @ 12.5 fl oz	7	90	56	59
Topsin 4.5 FL @ 20 fl oz	9	83	49	61
Endura @ 8 oz (2x)	0	60	23	68
Approach @ 8 oz (2x)	11	79	42	66
Topsin 4.5 FL @ 15 fl oz (2x)	3	90	50	62
LSD 0.05	11	NS	NS	8

All sprayed at R1 (July 10), and those with “(2x)” were sprayed again either 7 or 17 days later. Inoculated with white mold on July 21. DSI = disease severity index.

2013 – DeKalb, IL White Mold Fungicide Trial

Treatment	Incidence (%) 9-19-13	DSI (0-100) 9-19-13	Yield (bu/A)
Untreated	33	28	53
Fortix @ 5 fl oz	15	13	56
Incognito 4.5 F @ 20 fl oz	20	18	68
Incognito 4.5 F @ 20 fl oz (2x)	0	0	60
Domark @ 5 fl oz	3	2	62
Endura @ 8 oz	3	1	64
Proline @ 3 fl oz	10	7	60
Proline @ 5 fl oz	5	5	60
Aproach @ 9 fl oz	13	11	61
Aproach @ 9 fl oz (2x)	0	0	61
Cobra @ 6 fl oz	25	24	52
LSD 0.05	22	19	7

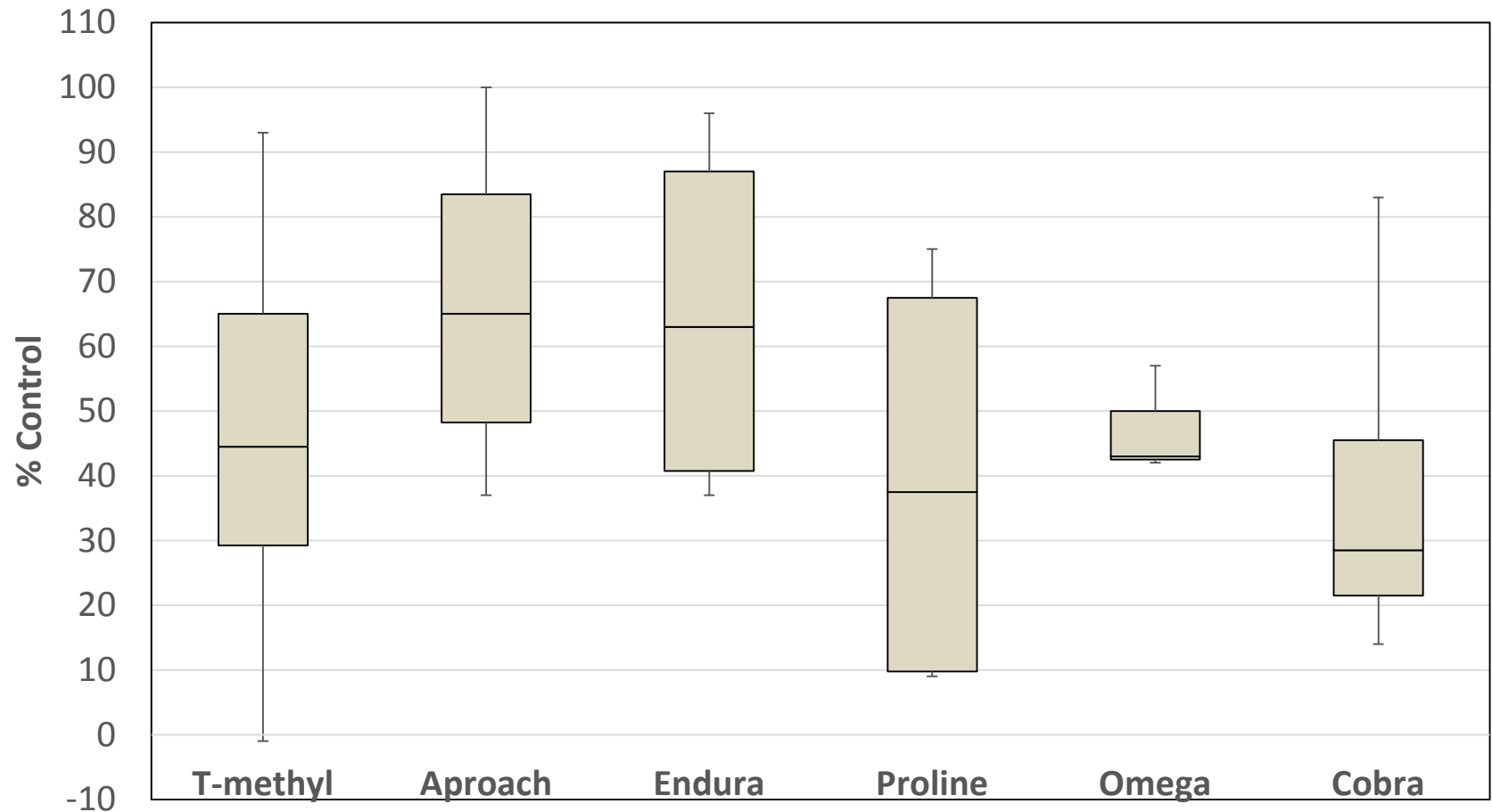
All sprayed at R1 (July 30), and those with “(2x)” were sprayed again 10 days later. Inoculated with white mold on July 30 after fungicides dried. DSI = disease severity index.

2014 – DeKalb, IL White Mold Fungicide Trial

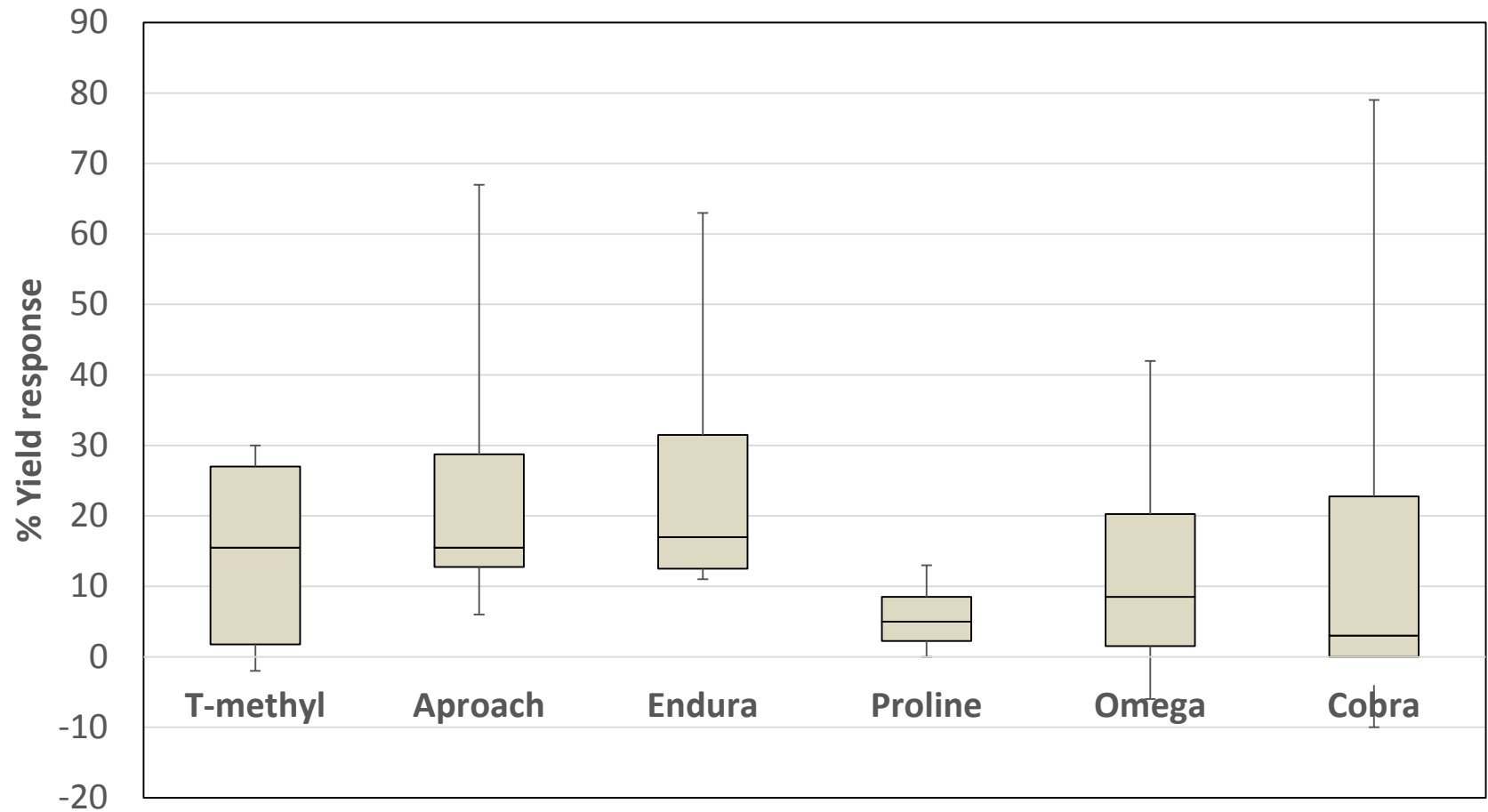
Treatment	Incidence (%) 9-19-14	DSI (0-100) 9-19-14	Yield (bu/A)
Untreated	81	49	45
Approach @ 9 fl oz (2x)	38	11	52
Fortix @ 5 fl oz	70	36	49
Cobra @ 6 fl oz	68	37	45
Endura @ 8 oz	43	8	51
Topsin 4.5 FL @ 20 fl oz	60	23	48
Proline @ 3 fl oz	53	17	48
Proline @ 5 fl oz	83	42	49
Omega @ 1 pt	60	28	47
LSD 0.05	NS	30	5

All sprayed at R1 (July 25), and those with “(2x)” were sprayed again 10 days later. Inoculated with white mold on July 28 after fungicides dried. DSI = disease severity index.

White mold control from University of Illinois Trials



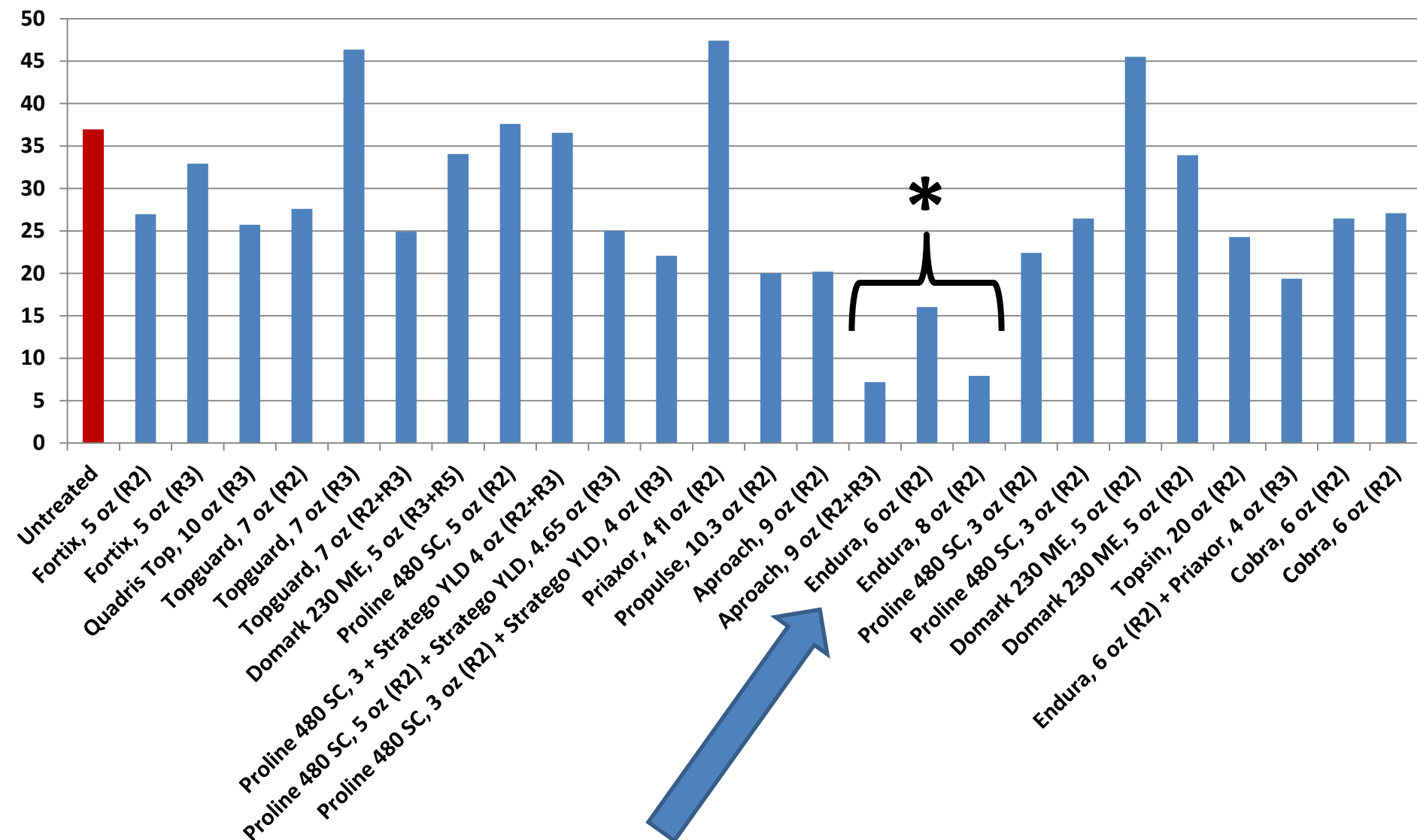
White mold control from University of Illinois Trials



Foliar fungicides – White mold

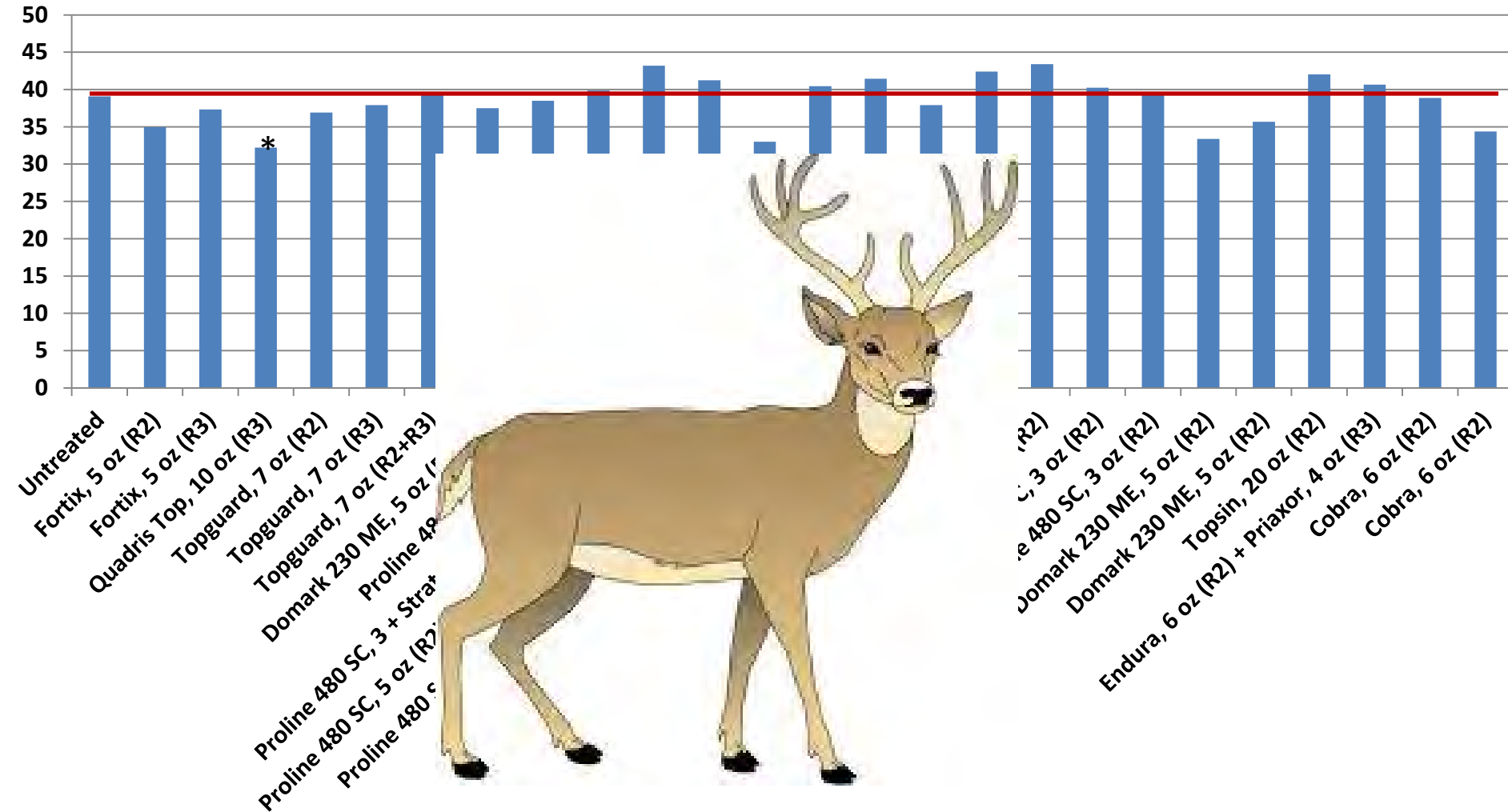


2013, white mold disease index (DSI)



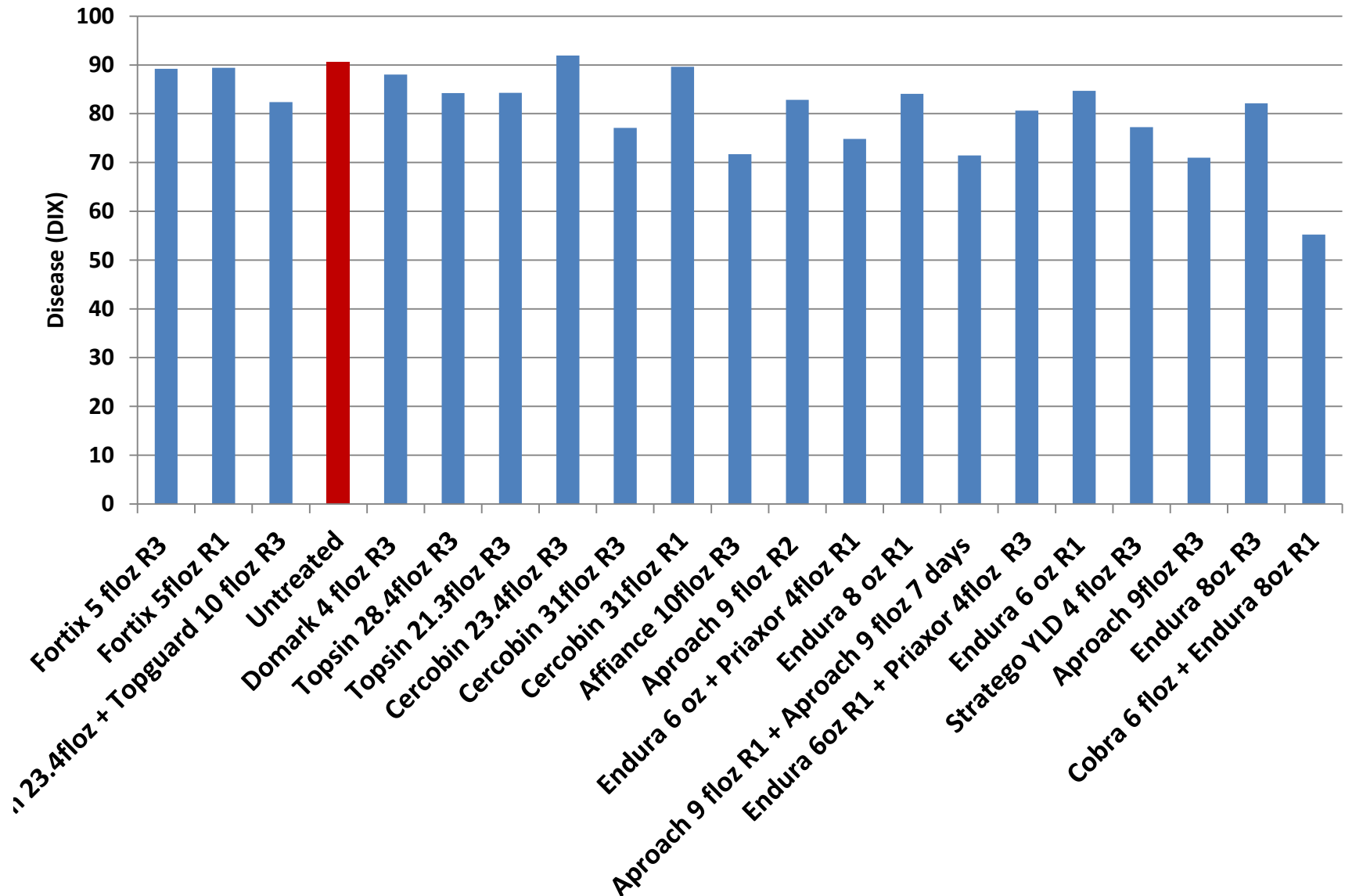
Approach 9oz (R2+R3); Endura 6oz (R2); Endura 8oz (R2)

2013, white mold yield (bu/A)



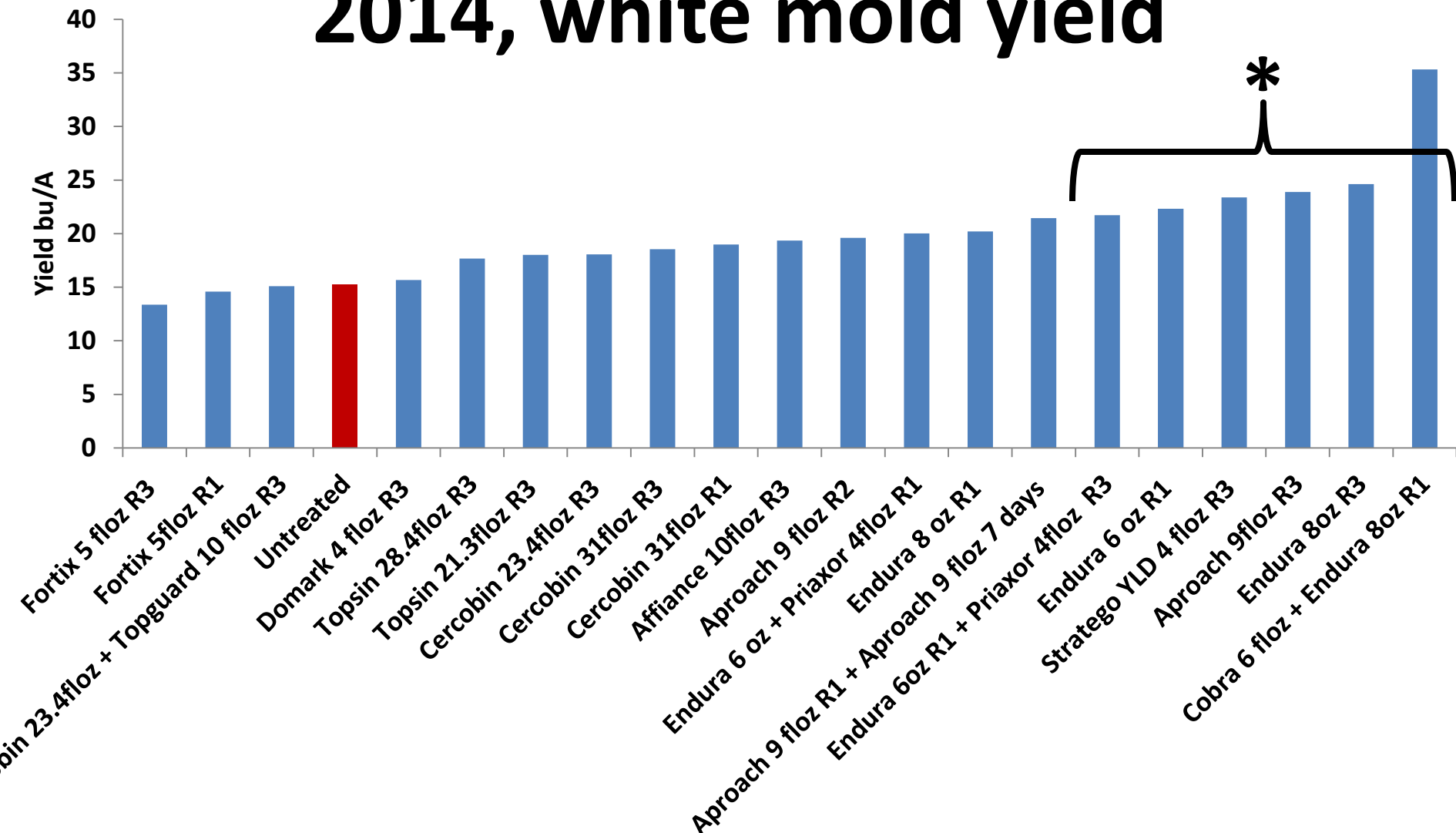
Significant deer pressure affected yield - None of the treatments significantly better than untreated

2014, white mold disease index (DSI)



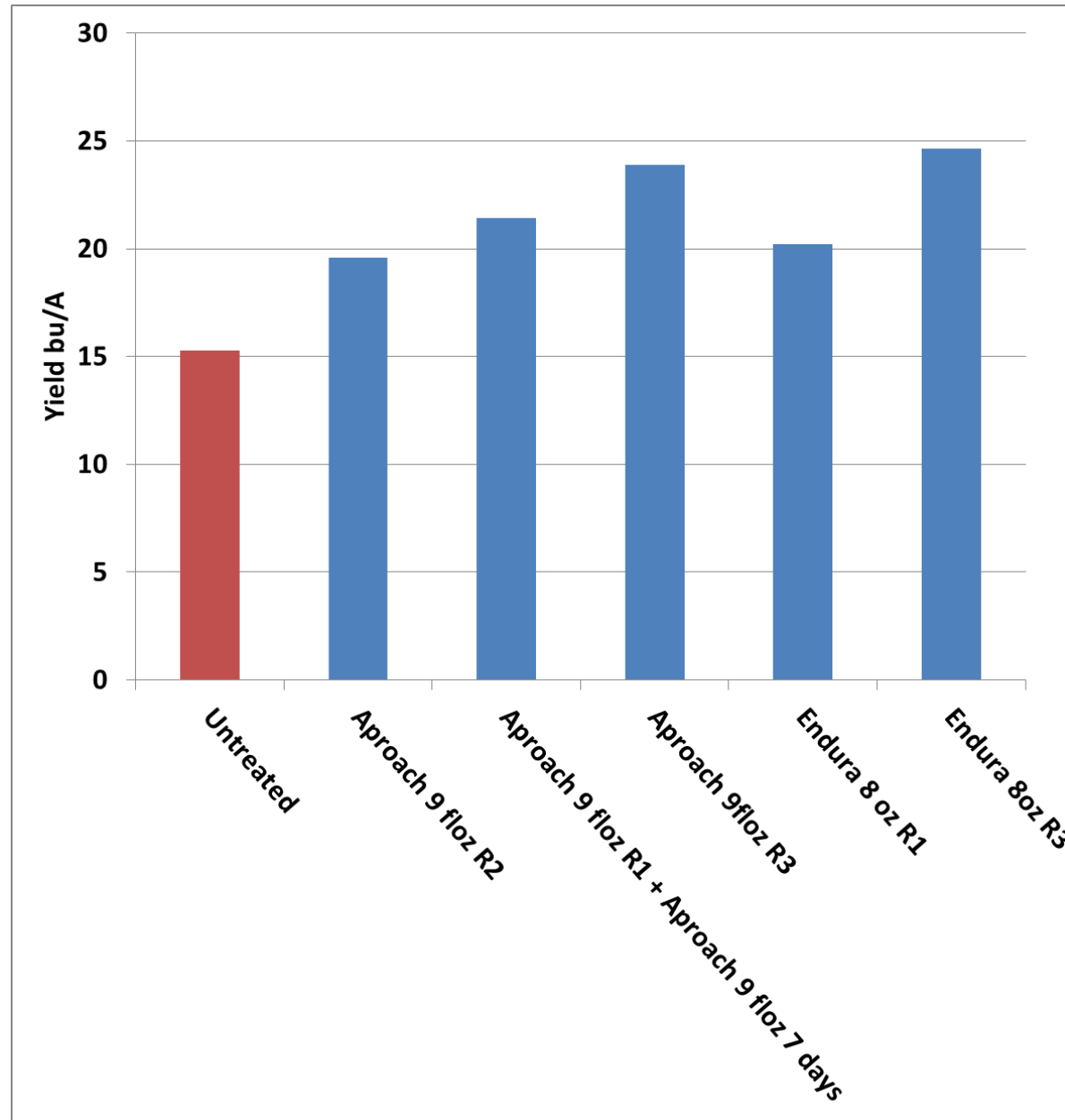
Disease pressure too high to statistically differentiate treatments

2014, white mold yield



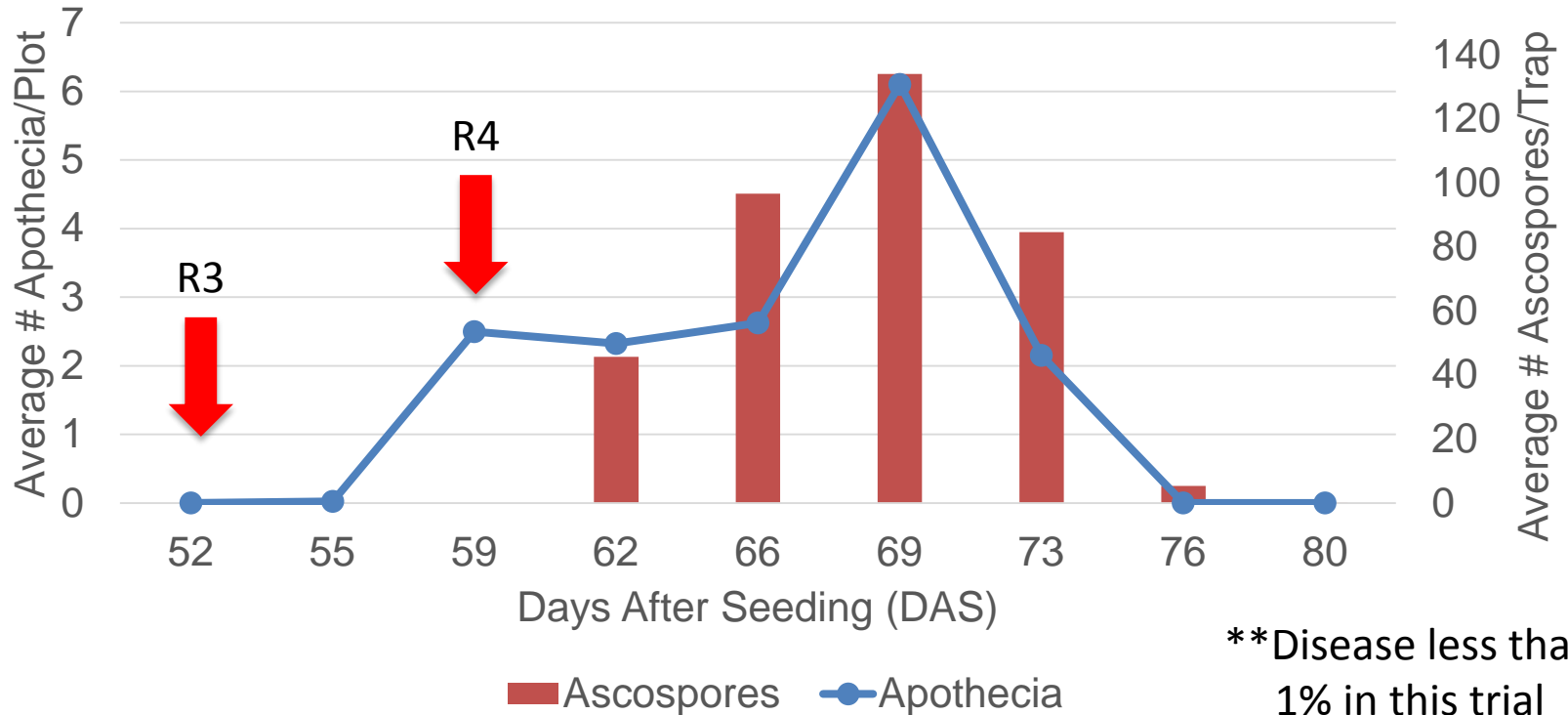
**Endura 6oz (R1) + Priaxor 4oz (R3); Endura 6oz (R1);
Stratego YLD 4oz (R3); Aproach 9oz (R3); Endura 8oz R3;
Cobra 6oz + Endura 8oz (R1)**

2014, application timing



Results: Apothecial Scouting and Ascospore Trapping

Appearance of Apothecia and Ascospores in 2014
Epidemiology Trial



White mold - Chemical control

- Chemical control as protectant not curative
- **Application timing to protect flowers up to beginning pod (R3)**
- Canopy penetration is essential



Thank You!



Acknowledgements

- Dr. Carl Druskovich,
- MSU diagnostic lab, Fred and Jan
- John Boyse and Randy Laurenz
- Tim Dietz and Kyle Johnson
- Kerrek Griffes, Steve Gower - Asgrow
- Karen Zuver – Pioneer
- Bill Widdicombe and Lori Williams
- Midwest colleagues: Kiersten Wise et al.



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Michigan Corn Growers Association

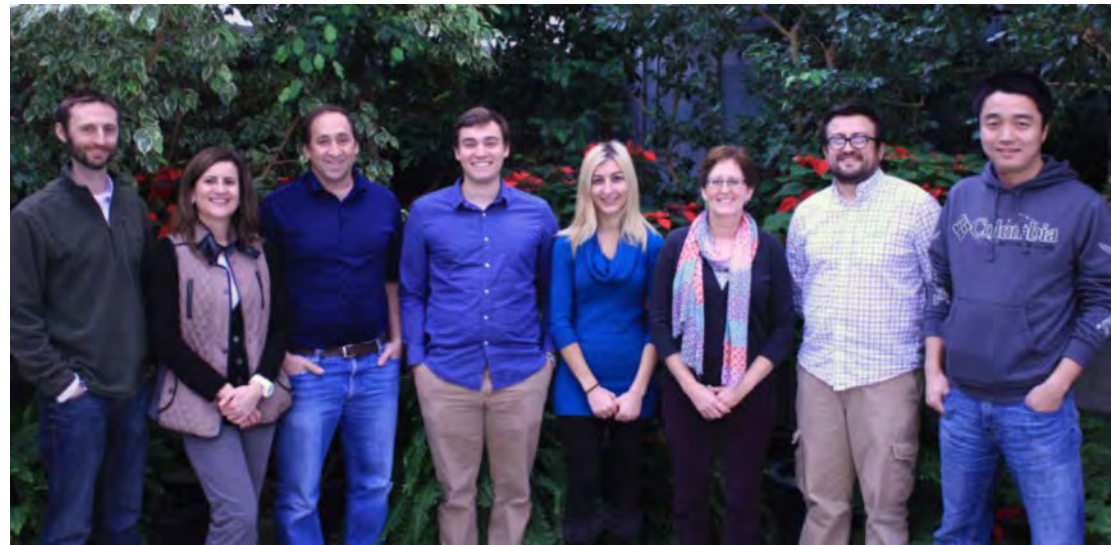


Michigan State University

AgBioResearch



National
Sclerotinia
Initiative



Plots were established at the Montcalm Research Farm in Entrican, MI. The 2013 crop was drybeans and soil type was a Montcalm sandy loam. Soybean variety AG2534 was planted on 3 Jun at 14 in. spacing and a rate of 120,000 seeds/A. Experimental design was a randomized complete block with 21 treatments and five replicates per treatment. Plots were six rows wide (7 ft) by 30 ft long. Fungicides were applied with a hand-held spray boom pressurized with CO₂ at 40 psi. The boom consisted of four nozzles (Teejet 11001VS) spaced 20 in. apart and was calibrated to apply 15 gal/A. White mold ratings were made on 22 Sep by scoring disease severity (DS) on all plants from a 5 ft section of a center row in each plot. Ratings were based on a 0-3 scale (Grau et al. 1982, Plant Disease, 66:506-508) and converted to a disease index (DIX) that accounted for severity and incidence (DI): $DIX = DI * (DS/3)$. Plot-wide leaf retention estimates were made on 24 Sep. The middle 25 ft of the four center rows were harvested on 3 Nov and yields were adjusted to 13% moisture. Data was analyzed using SAS 9.3 PROC MIXED method (SAS Institute, Cary, NC).

White mold pressure was very high, with untreated plots averaging 94.4% disease incidence. There were no significant differences in white mold incidence or DIX values, likely due to the very high pressure overwhelming any treatment effects. Four treatments had significantly greater leaf retention, compared to the untreated. The Cobra + Endura treatment, which was applied at R1, had the lowest DIX value, highest percent leaf retention, and significantly out yielded all other treatments; visually, this treatment clearly stood out amongst the other plots as providing the best disease control. Aside from the Cobra + Endura treatment, treatments applied at R3 tended to have higher leaf retention and yields than those applied at R1 or R2. No unexpected phytotoxicity of the tested products was noted; Cobra, as expected, caused scorching of the upper canopy.

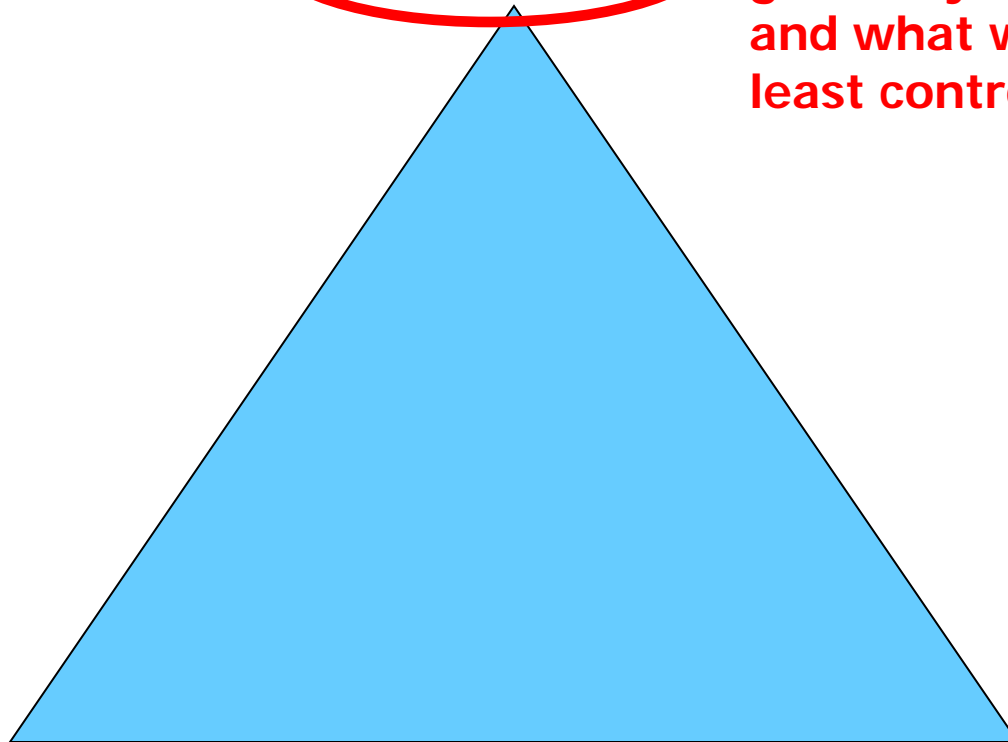
Treatment, rate/A	Application date	Plant stage	DIX	% Leaf Retention	Yield (bu/A)
Untreated	24 Jul	R1	90.49	16.0 e ^z	15.281 cde
Cercobin, 31 fl oz	8 Aug	R3	89.63	23.0 de	18.994 bcd
Cercobin, 23.4 fl oz	8 Aug	R3	91.92	35.0 bcd	18.061 bcde
Cercobin, 31 fl oz	8 Aug	R3	77.10	34.0 cde	18.537 bcd
Topsin, 21.3 fl oz	8 Aug	R3	84.29	22.0 de	18.013 bcde
Topsin, 28.4 fl oz	8 Aug	R3	84.22	36.0 bcd	17.670 bcde
Cercobin, 23.4 fl oz + Topguard, 10 fl oz	8 Aug	R3	82.37	23.0 de	15.099 cde
Fortix, 5 fl oz	24 Jul	R1	89.43	31.0 de	14.591 de
Fortix, 5 fl oz	8 Aug	R3	89.21	31.0 de	13.368 e
Stratego YLD, 4 fl oz	8 Aug	R3	77.26	59.0 ab	23.387 b
Affiance, 10 fl oz ^y	8 Aug	R3	71.68	55.0 bc	19.362 bcd
Domark 230 ME, 4 fl oz ^y	8 Aug	R3	88.04	21.0 de	15.677 cde
Aproach 2.08 SC, 9 fl oz ^y + Aproach 2.08 SC, 9 fl oz ^y	24 Jul 31 Jul	R1 R2	 71.44	 37.0 de	 21.441 bcd
Aproach 2.08 SC, 9 fl oz ^y	31 Jul	R2	82.85	20.0 e	19.602 bcd
Aproach 2.08 SC, 9 fl oz ^y	8 Aug	R3	70.97	60.0 ab	23.898 b
Endura, 6 oz ^y	24 Jul	R1	84.69	36.0 cde	22.324 b
Endura, 8 oz ^y	24 Jul	R1	84.05	25.0 de	20.201 bc
Endura, 8 oz ^y	8 Aug	R3	82.13	62.0 ab	24.623 b
Cobra, 6 fl oz + Endura, 8 oz ^y	24 Jul	R1	55.24	87.6 a	35.316 a
Endura, 6 oz + Priaxor, 4 fl oz ^y	24 Jul	R1	74.84	40.0 bcd	20.017 bcd
Endura, 6 oz ^y + Priaxor, 4 fl oz ^y	24 Jul 8 Aug	R1 R3	 80.61	 36.0 cde	 21.716 b
P-value			0.2340	<0.0001	<0.0001

Disease Triangle

Environment

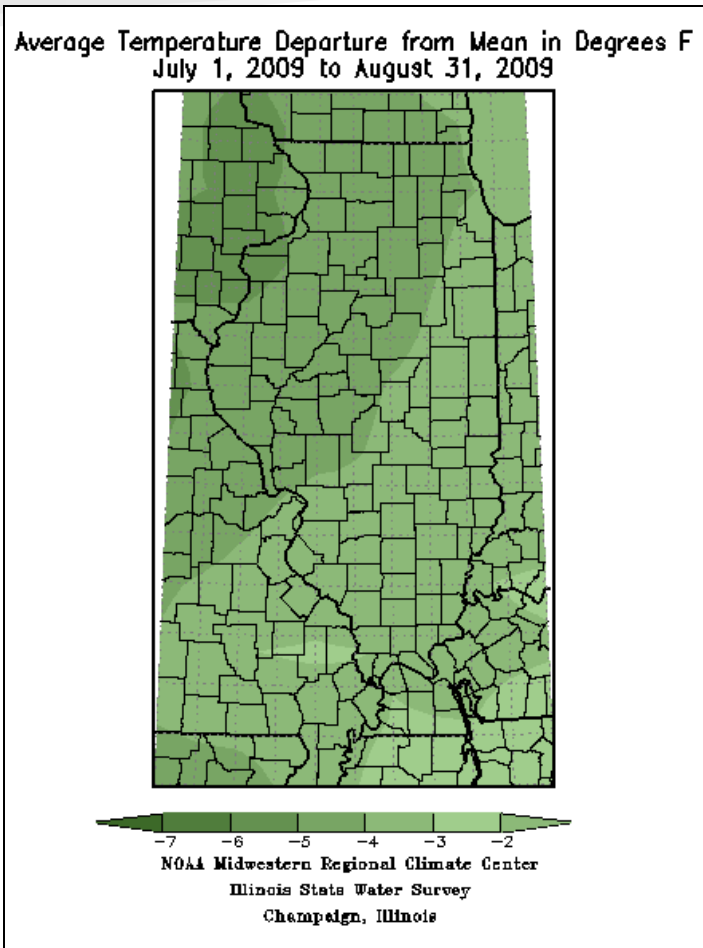
Environment is generally the driver, and what we have the least control of!

Pathogen

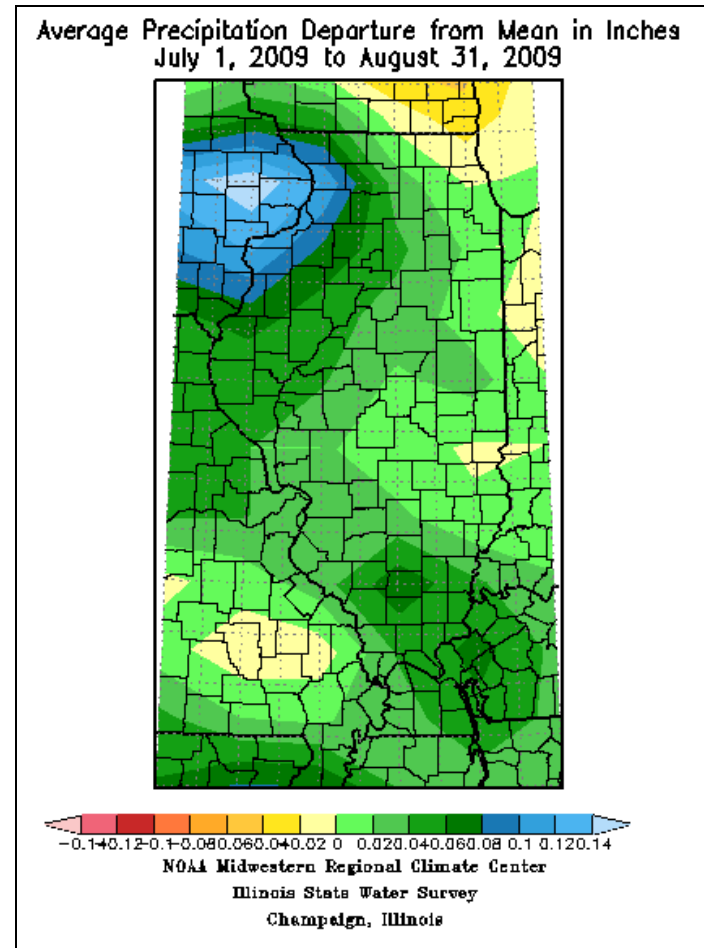


Susceptible
Host

Why was white mold such a problem in IL in 2009?



Low Temperatures



Excessive/Adequate Moisture

***Sclerotinia sclerotiorum* - ascospore discharge**



Drawing: Marilyn Hovius

Soilborne sclerotia

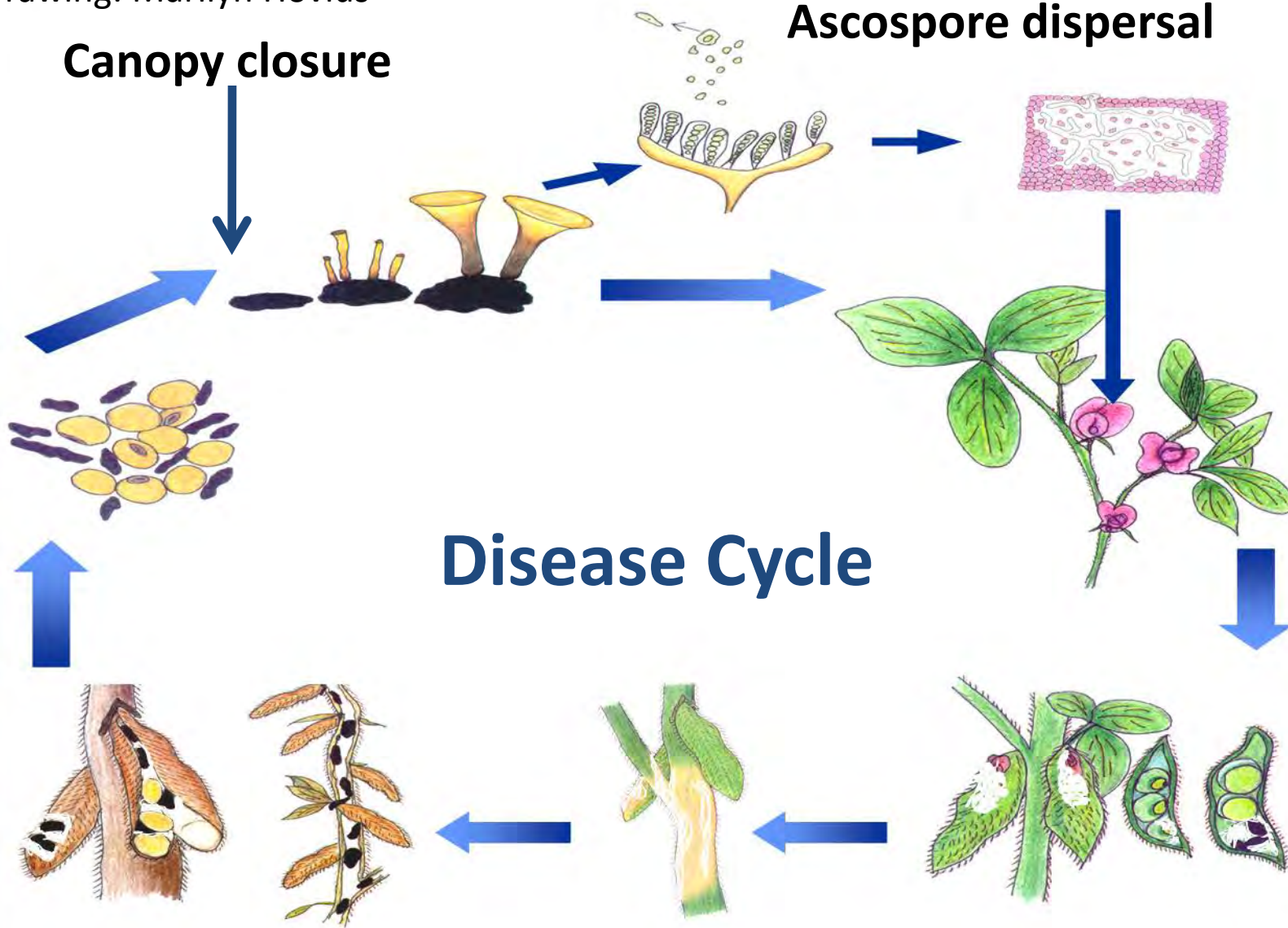
Canopy closure

Ascospore dispersal

Disease Cycle

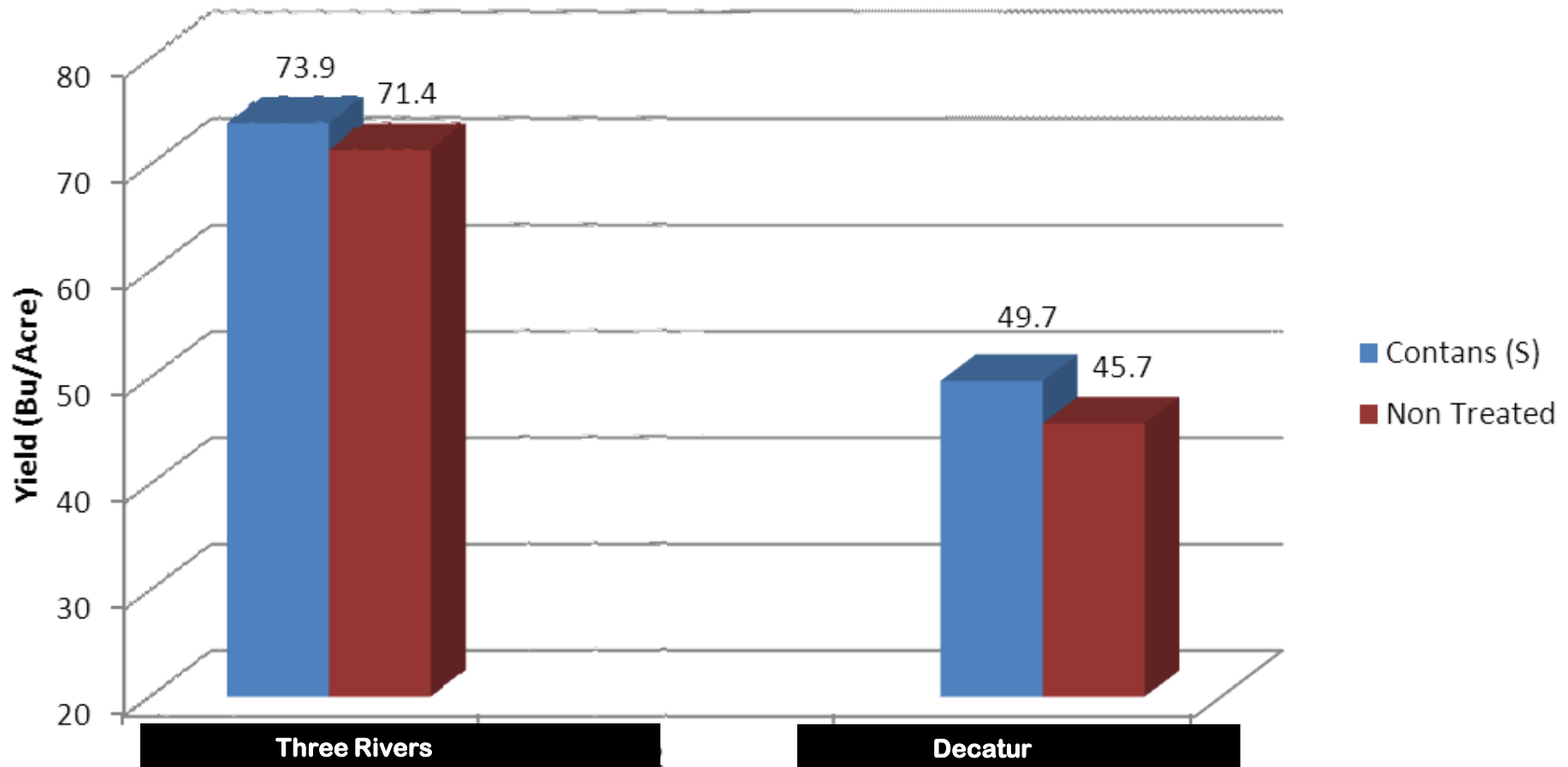
Disease and sclerotia development occur from
R3 to R8 growth stages

Slide Courtesy of Craig Grau



2011 Yield Results

Yield Response to Contans Treatment



Impact of Contans at reducing number of Sclerotia per liter of soil

Application timing of Contans @ 3 lbs/acre	Sampling date	Fall Application	Spring Application	Untreated Control
F 09, S 10	Aug 2010	2.7	2.9	2.9
F 09, S 10	Aug 2011	2.0	1.4	2.9
F 10 & 11 or S 10 & 11	Aug 2011	2.0	1.3	2.3
F 10 or S 11	Aug 2011	2.0	1.4	2.8
average	---	2.2	1.8	2.7

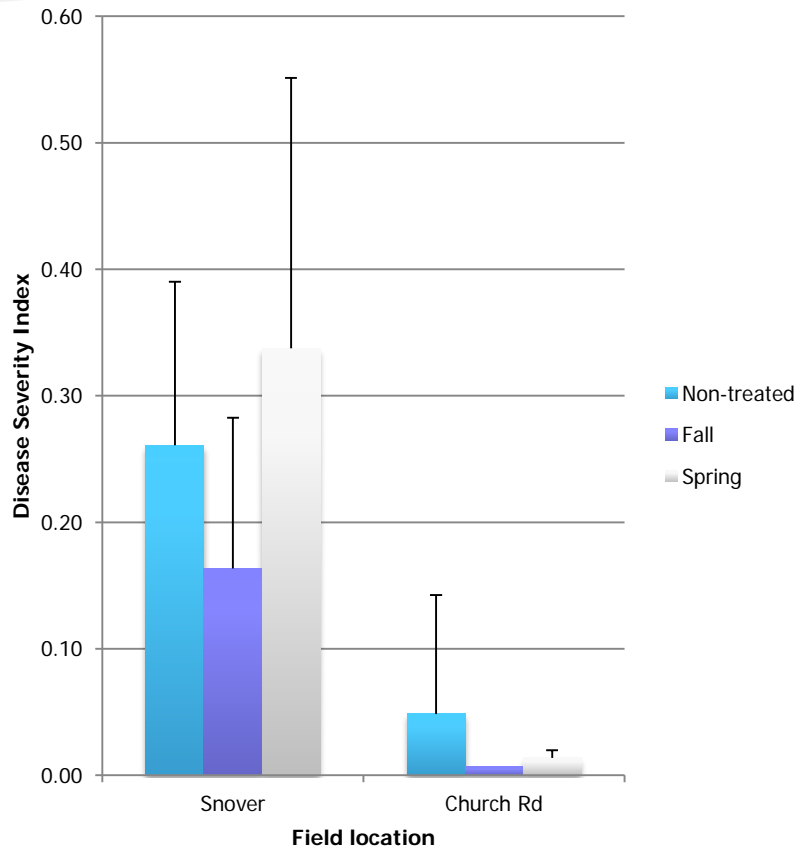
Data from research conducted in Sanilac County in 2010 and 2011.

Variety resistance

- No complete resistance is available
- Varieties do differ in their resistance levels
 - Physiological
 - Escape, flowering time and architecture
- www.varietytrials.msu.edu

MSU Contans trials

2010 Contans Trial A



2010 Contans Trial B

