

**INTERACTION OF FOLIAR FUNGICIDES WITH CULTIVAR IN
DOUBLE-CROPPED SOYBEAN**

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A common crop rotation in the Mid-Atlantic USA is corn or cotton followed by winter wheat then soybean. Soybean is planted immediately after the wheat harvest in June; hence three crops are grown in two years. Due to late development of the soybean crop, there is a higher probability of foliar diseases. Although the most effective and economical method for soybean disease management is genetic resistance, agronomically-acceptable and broad-spectrum disease resistant soybean cultivars are not generally available. In response, soybean farmers manage late-season diseases with fungicides but the yield response to foliar fungicides is inconsistent. Furthermore, field observations and on-farm non-replicated experiments indicated that cultivars respond differently to fungicides. Therefore, experiments were conducted to evaluate the response and specific interaction between soybean cultivars and foliar fungicide application in a wheat-soybean double-crop system. Field experiments were conducted at four locations in Virginia during 2012. Two experiments were conducted at each location: one containing maturity group IV cultivars and one containing maturity group V cultivars. The experimental design was a randomized complete block in a strip-plot arrangement. Vertical plots included 10 cultivars with varying levels of disease resistance. Horizontal plots included an untreated control and foliar fungicide application (2:1 premix of pyraclostrobin and fluxapyroxad) at development stages R3 (beginning pod), R5 (beginning seed), or R3 + R5. Disease incidence was assessed and NDVI measurements were obtained weekly beginning at the R2 (full flower) stage and through R7 (physiological maturity). Beginning at R6 (full-seed), percent defoliation was measured weekly until R8. Yield and yield components were measured. Results will be presented at the conference.

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Presentation Outline

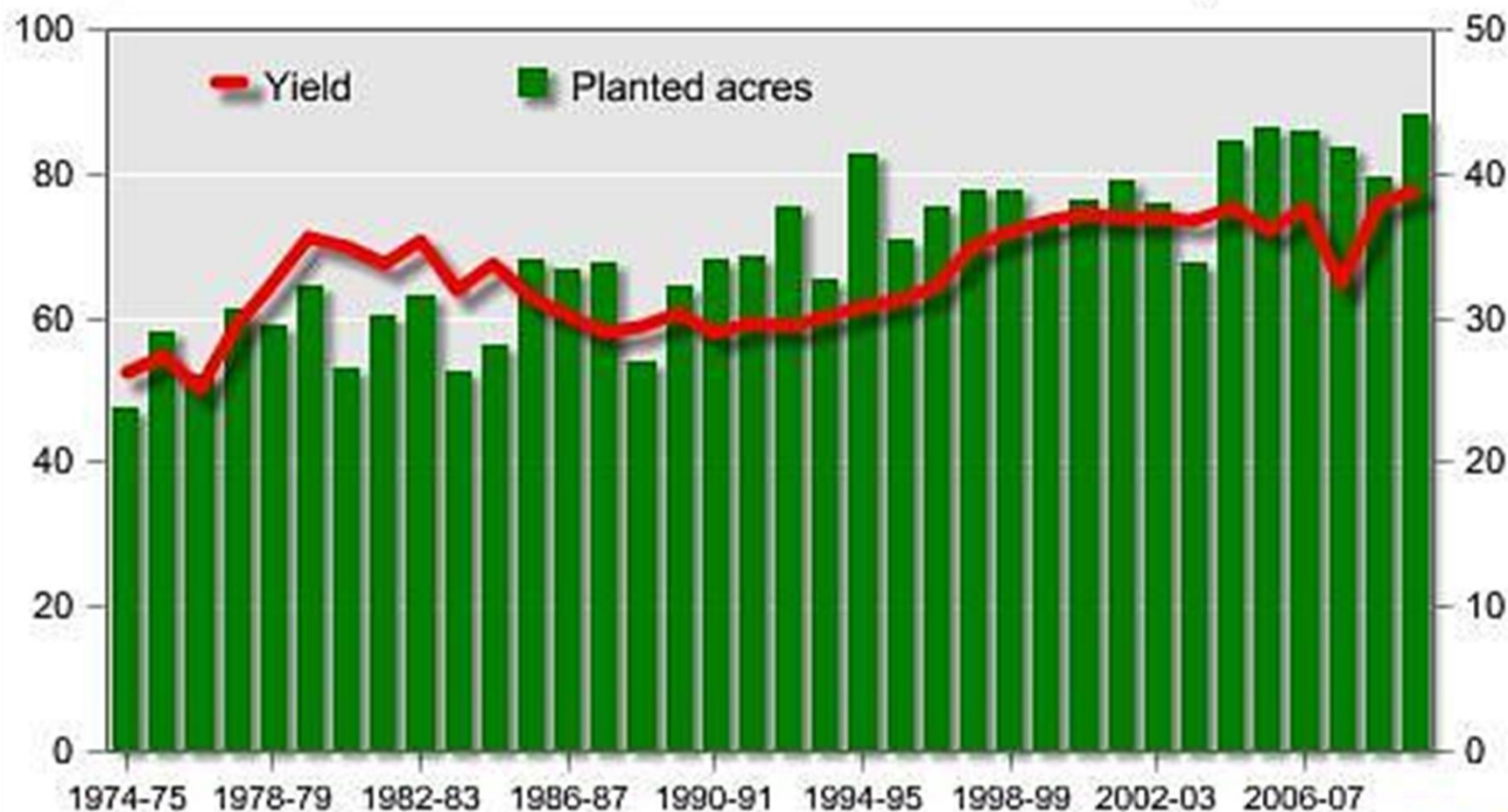
- Introduction
- Objectives
- Materials & Methods
- Results & Discussion
- Conclusion
- Acknowledgements
- Questions/Comments



U.S. soybean acreage and yield

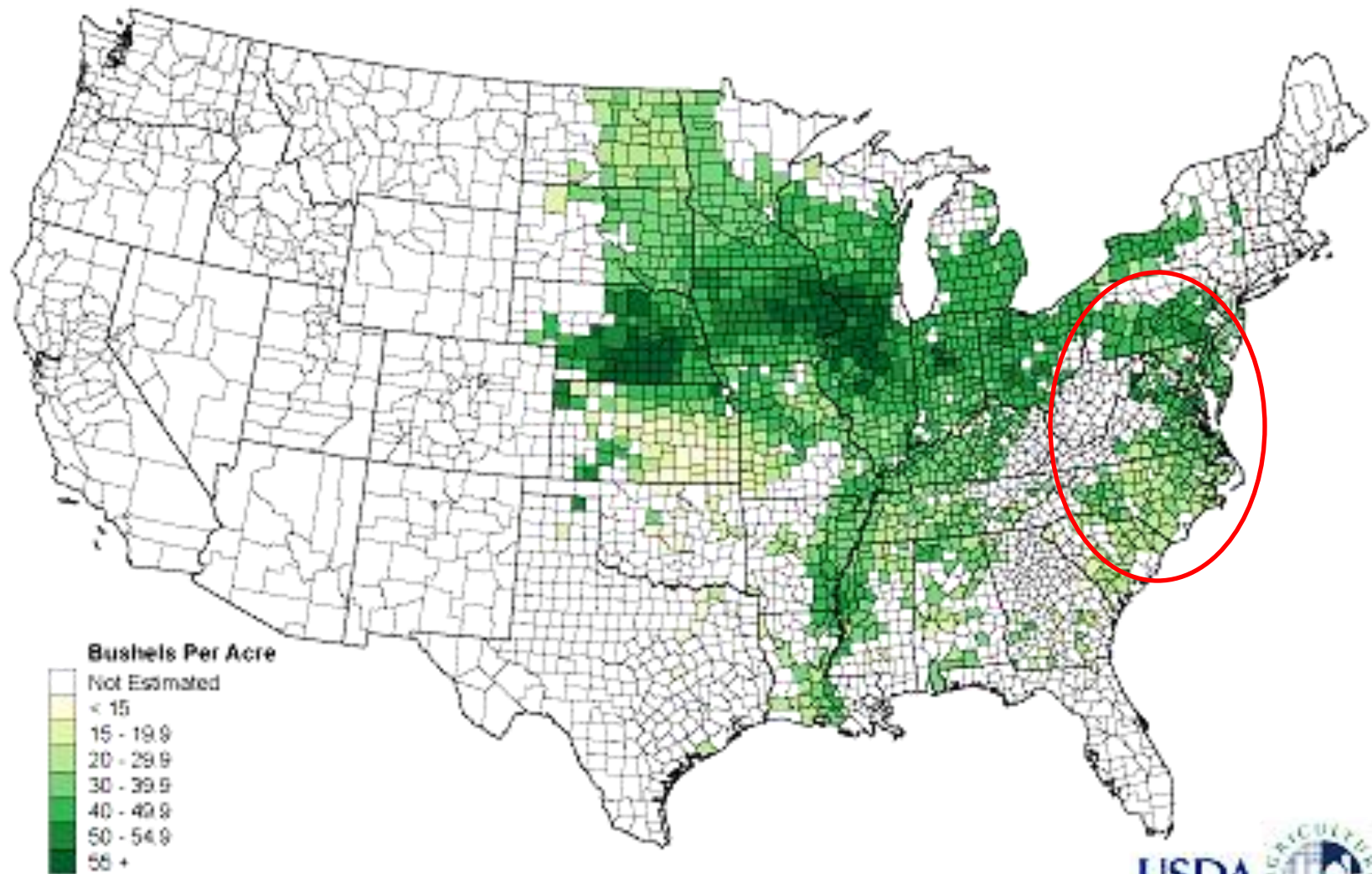
Million planted acres

Bushels per harvested acre

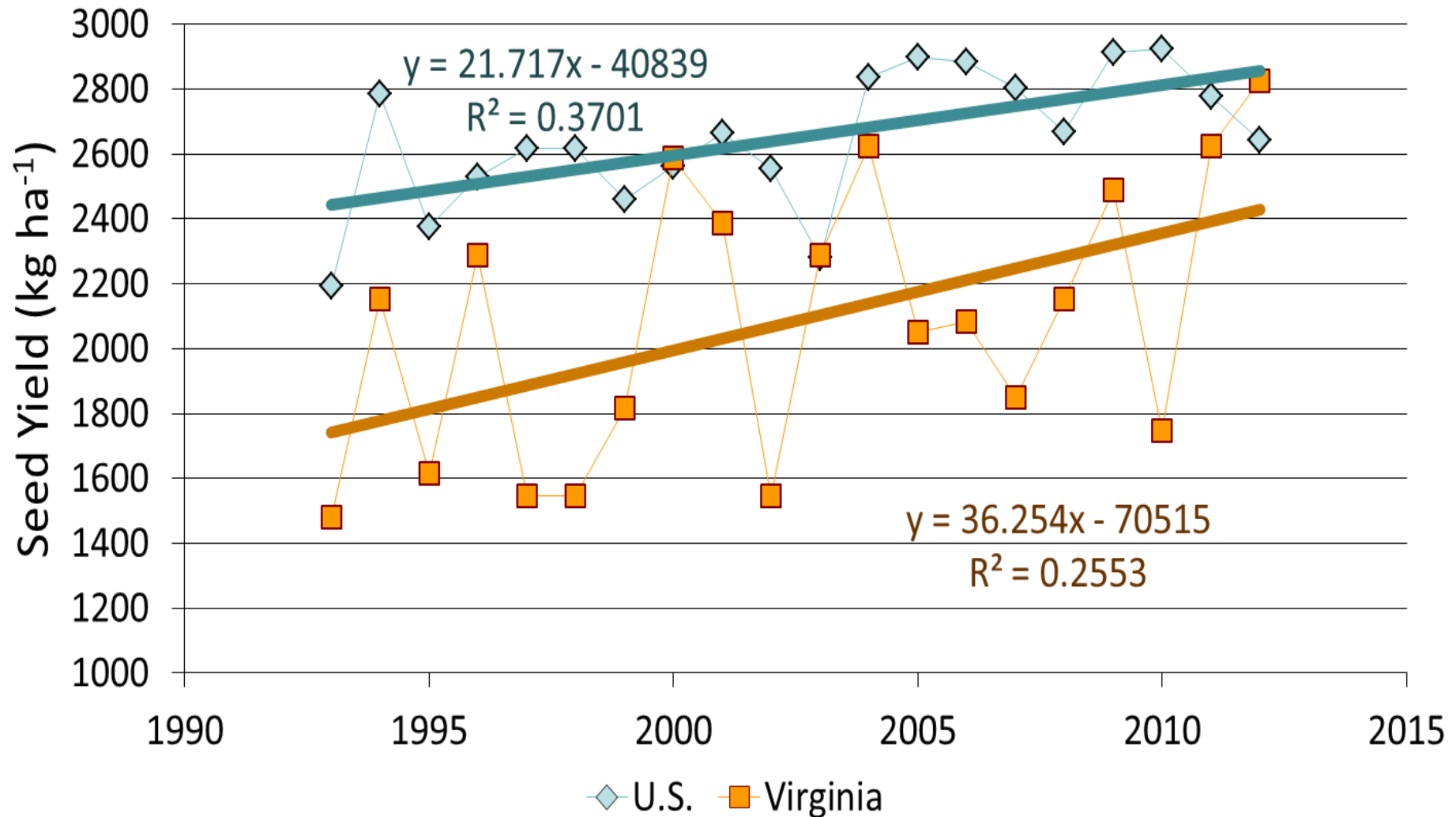


Source: USDA, World Agricultural Outlook Board, World Agricultural Supply and Demand Estimates.
Updated: March 2010.

Soybeans 2011
Yield Per Harvested Acre by County
for Selected States



Virginia versus U.S. Soybean Yield

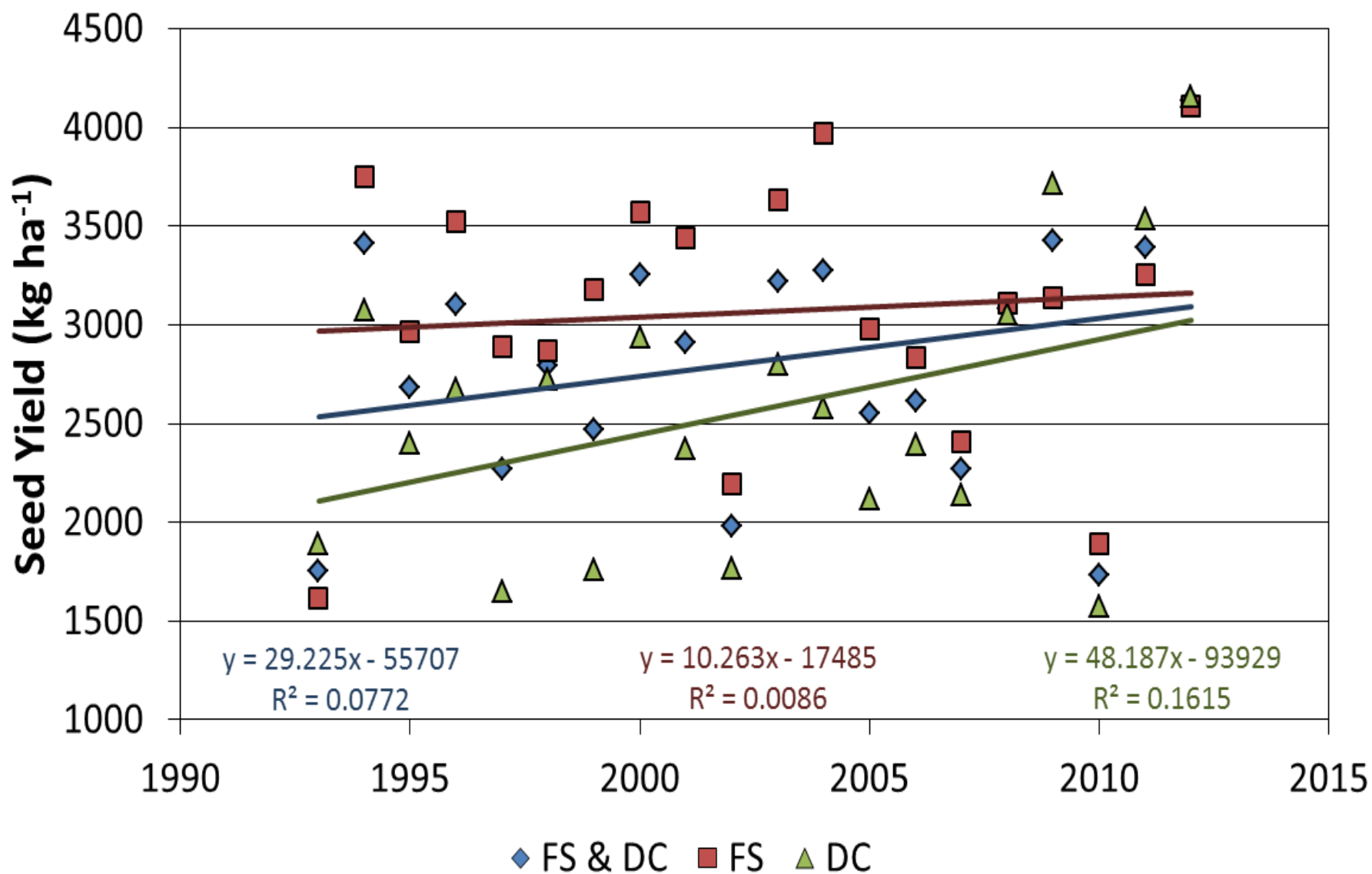






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Virginia Soybean Yields (VT OVT)



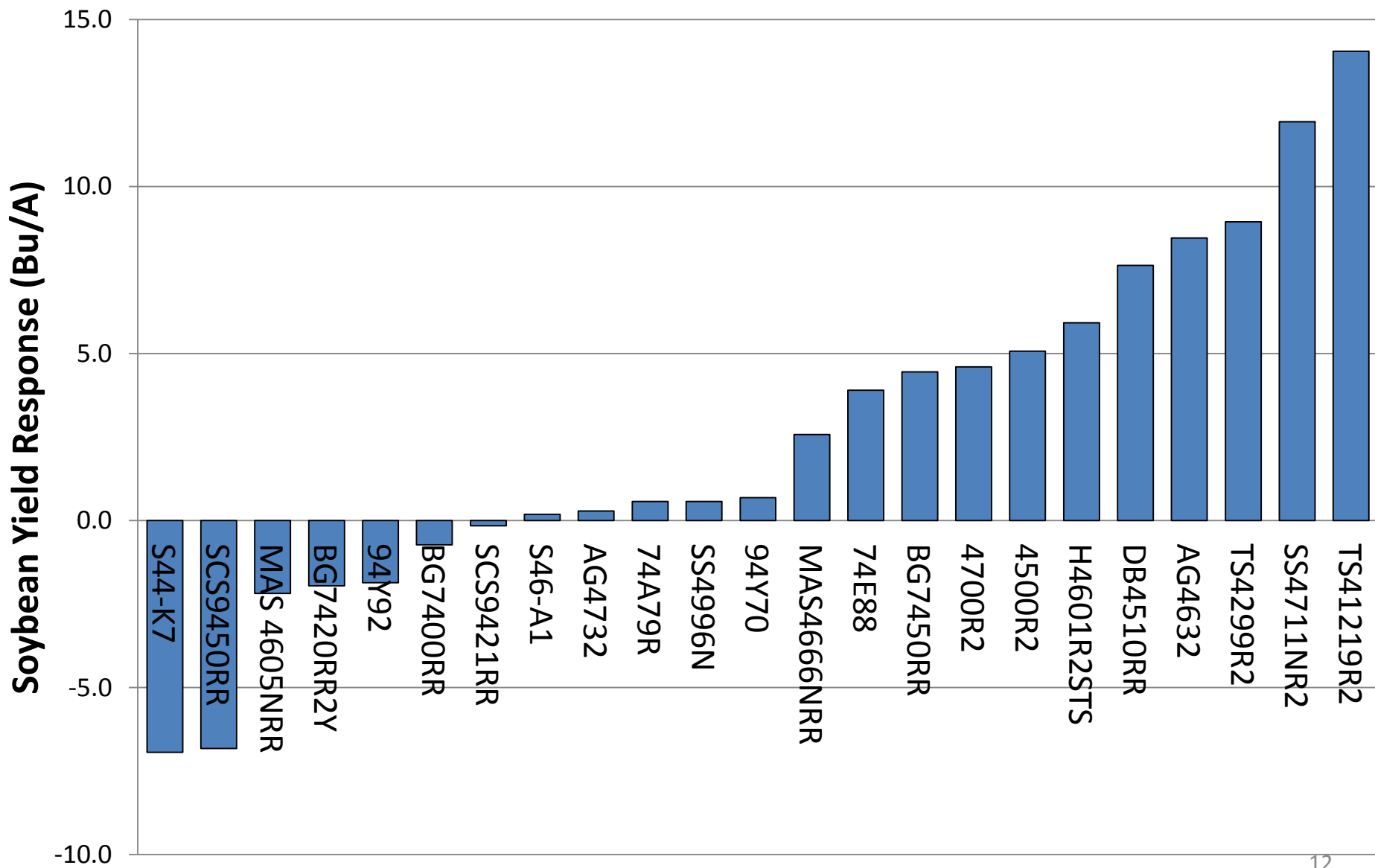
Virginia Soybean Disease Incidence

- Total yield reduction of 7.15%
 - (Phipps and Telenko, 2011)
- Nematodes: 5% yield loss
 - Soybean cyst, southern and northern root-knot, sting, and stubby root
- **Cercospora blight**: 0.5% yield loss
 - Most prevalent foliar disease
- Leaf spot diseases: 0.4% yield loss
 - Brown spot, frogeye leaf spot, and anthracnose
- Pod and stem blight: 0.1% yield loss
- No yield loss due to Soybean Rust to date





2011 Variety Response to Strobilurin Fungicide





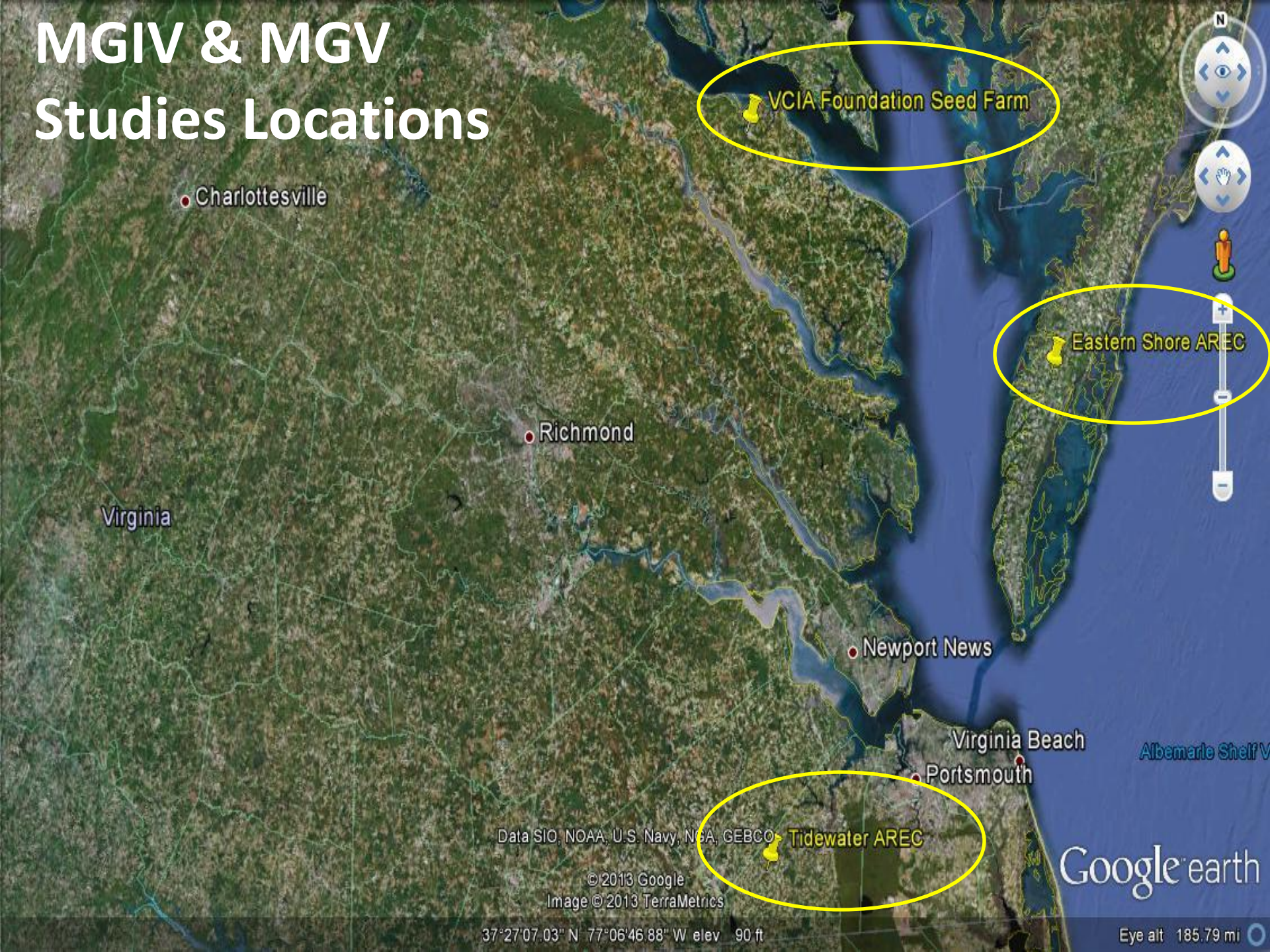
Objectives

- Evaluate the response and specific interaction between soybean MGIV and V cultivars and foliar fungicide application in a wheat-soybean double-crop production system

MGIV & MGV Studies Locations (3)

- Eastern Shore Agricultural Research & Extension Center (ESAREC)
 - Painter, VA
 - Soil: Bojac sandy loam
 - Latitude/Longitude: 37°35'9.82"N, 75°49'29.58"W
- Tidewater Agricultural Research & Extension Center (TAREC)
 - Suffolk, VA
 - Soil: Dragston fine sandy loam
 - Latitude/Longitude: 36°40'56.20"N, 76°45'55.76"W
- Virginia Crop Improvement Foundation Seed Farm
 - Mt. Holly, VA
 - Soil: State fine sandy loam
 - Latitude/Longitude: 38° 5'0.16"N, 76°42'39.49"W

MGIV & MGVS Studies Locations



Materials & Methods: MGIV & V Studies

- Factors (2)
 - Foliar Fungicide Application Timing (4)
 - Untreated
 - R3 (beginning pod)
 - R5 (beginning seed)
 - Both R3+R5
 - Priaxor[®] (2:1 pre-mix of a.i. pyraclostrobin and Xemium, BASF Corporation, Research Triangle Park, NC)
 - Soybean cultivar (10)

MGIV Cultivars

- Asgrow
 - AG4632
 - AG4732
- Pioneer
 - 94Y22
 - 94Y70
- Progeny
 - P4811RY
- Public VA
 - V04-1022
- Southern States
 - SS-4711R2
 - SS-4700R2
- USG
 - 74A79R
 - 74B81R

MGV Cultivars

- Asgrow
 - AG5332
 - AG5632
- NK
 - S51-J3
 - S56-G6
- Pioneer
 - 95Y40
 - 95Y60
- Progeny
 - P5610RY
 - P5655RY
- Southern States
 - SS-5112NR2
 - SS-5510NR2

Materials & Methods: MGIV & V Studies

- Experimental design
 - Strip plot, RCBD
 - Vertical plots = soybean cultivars
 - Horizontal plots = foliar fungicide application timings
 - 4 replications
 - 40 treatment combinations rep⁻¹
 - 160 plots study⁻¹

Studies Experimental Design

16	440	439	438	437	436	435	434	433	432	431
15	421	420	423	424	425	426	427	428	429	430
14	420	419	418	417	416	415	414	413	412	411
13	401	402	403	404	405	406	407	408	409	410
12	340	339	338	337	336	335	334	333	332	331
11	321	322	323	324	325	326	327	328	329	330
10	320	319	318	317	316	315	314	313	312	311
9	301	302	303	304	305	306	307	308	309	310
8	240	239	238	237	236	235	234	233	232	231
7	221	222	223	224	225	226	227	228	229	230
6	220	219	218	217	216	215	214	213	212	211
5	201	202	203	204	205	206	207	208	209	210
4	140	139	138	137	136	135	134	133	132	131
3	121	122	123	124	125	126	127	128	129	130
2	110	119	118	117	116	115	114	113	112	111
1	101	102	103	104	105	106	107	108	109	110
		2		4	5	6	7	8	9	10

Untreated
R3
R5
R3+R5

Studies Experimental Design: Rep 1

3	121	122	123	124	125	126	127	128	129	130
1	101	102	103	104	105	106	107	108	109	110
	1	2	3	4	5	6	7	8	9	10

Untreated
R3
R5
R3+R5



MGIV Painter



MGIV Mt. Holly



MGIV & V Suffolk



MGIV & V Mt. Holly



Materials & Methods: MGIV & V Studies

- Plot size
 - 5 rows
 - 38 cm row width
 - 5.2 m length
- Planting
 - Planted no-till into wheat stubble after wheat harvest
 - Plot planter
 - Seeding rate: 592,800 seed ha⁻¹



Materials & Methods: MGIV & V Studies

- Canopy reflectance with NDVI (GreenSeeker)
 - R3 & R5





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Materials & Methods: MGIV & V Studies

- Foliar Fungicide Application Timing
 - Priaxor[®] (2:1 pre-mix of a.i. pyraclostrobin and Xemium)
 - Rate: 292 mL ha⁻¹ + Induce[®] non-ionic surfactant at 460 mL ha⁻¹ (0.25% v/v)
 - At least 141 L ha⁻¹ water volume





Materials & Methods: MGIV & V Studies

- Disease incidence
 - At each application timing
 - Sampled untreated plots from all 4 reps
 - Total of 10 leaves plot⁻¹
 - 5 leaves from upper canopy
 - 5 leaves from lower canopy
 - Leaf Incubation = ID specific disease presence in canopy
- Disease ratings
 - Weekly after R6
 - Cercospora Leaf Blight
 - % Stem area
 - % Leaf area

Materials & Methods: MGIV & V Studies

- % Defoliation
 - R6-R8
 - Weekly ratings
 - Canopy reflectance with NDVI
- % Yellowing
 - R6-R8
 - Weekly ratings



Materials & Methods: MGIV & V Studies

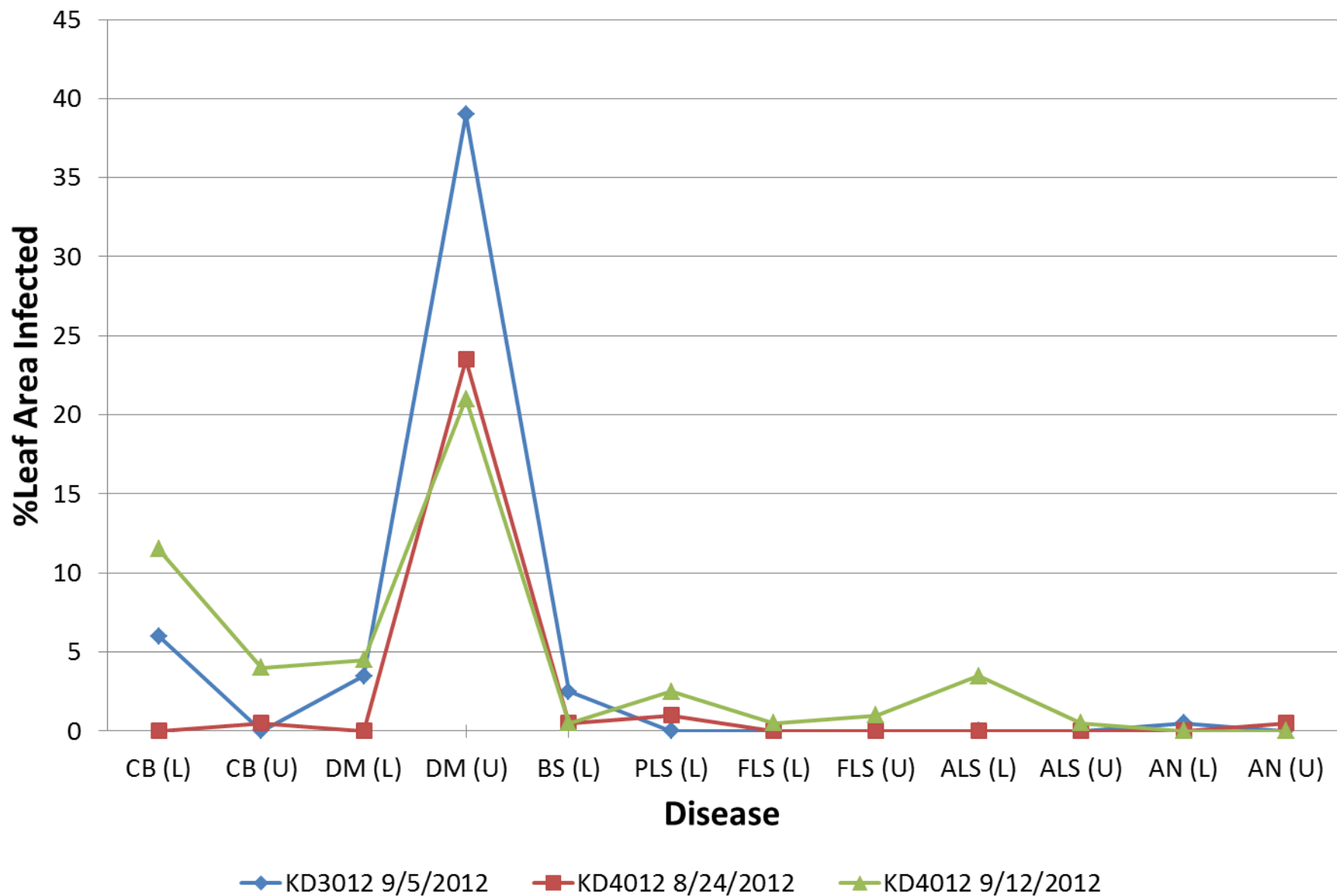
- Harvest
 - Seed yield
 - Middle 3 rows of plot with small plot research combine
 - Subsample
 - 100 seed weight
 - Seed quality ratings



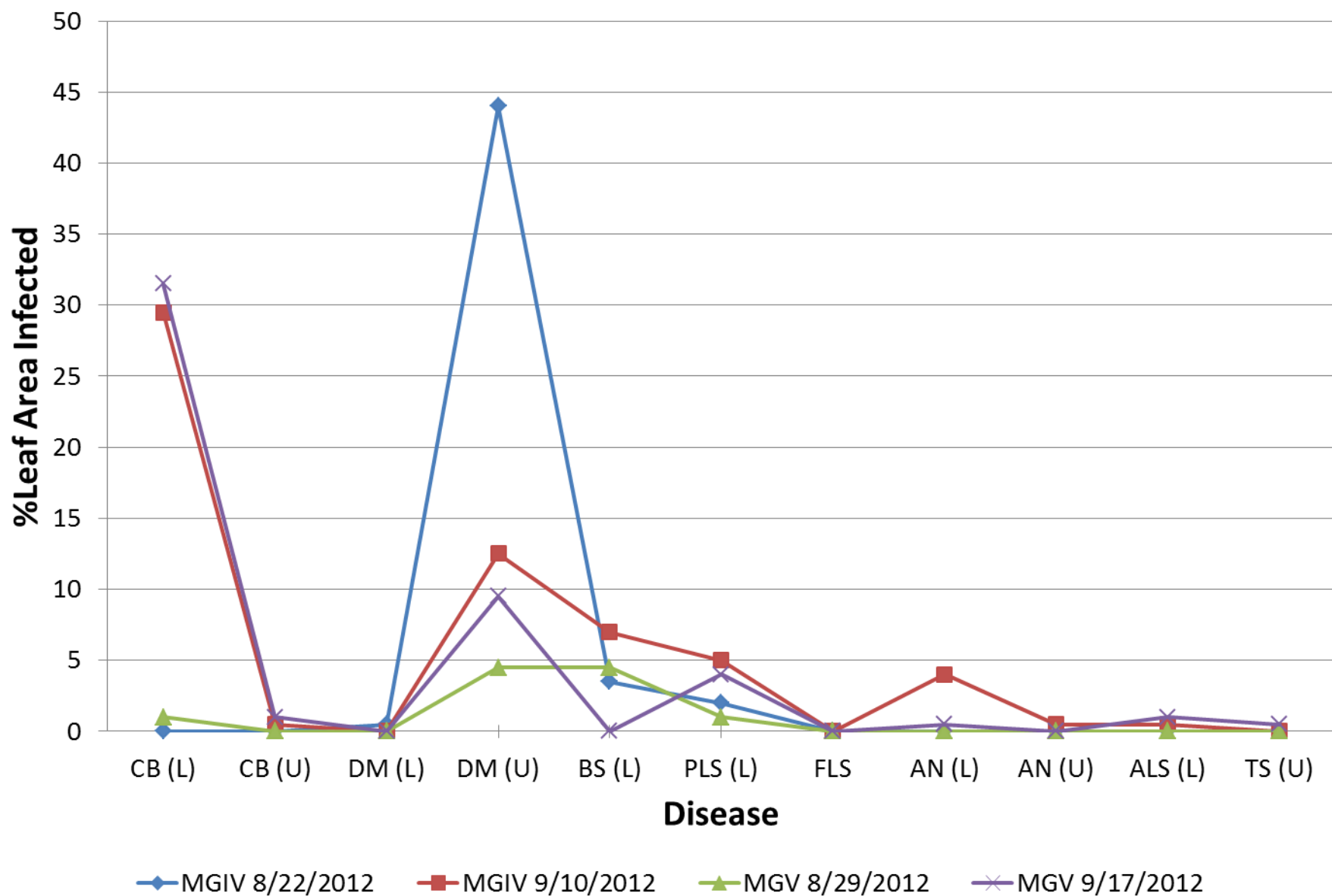
Materials & Methods: MGIV & V Studies

- Statistical Analysis
 - Proc Mixed (SAS, 2008)
 - Cultivar and fungicide application considered fixed
 - Replicate considered random
 - $P < 0.05$ used for mean separation

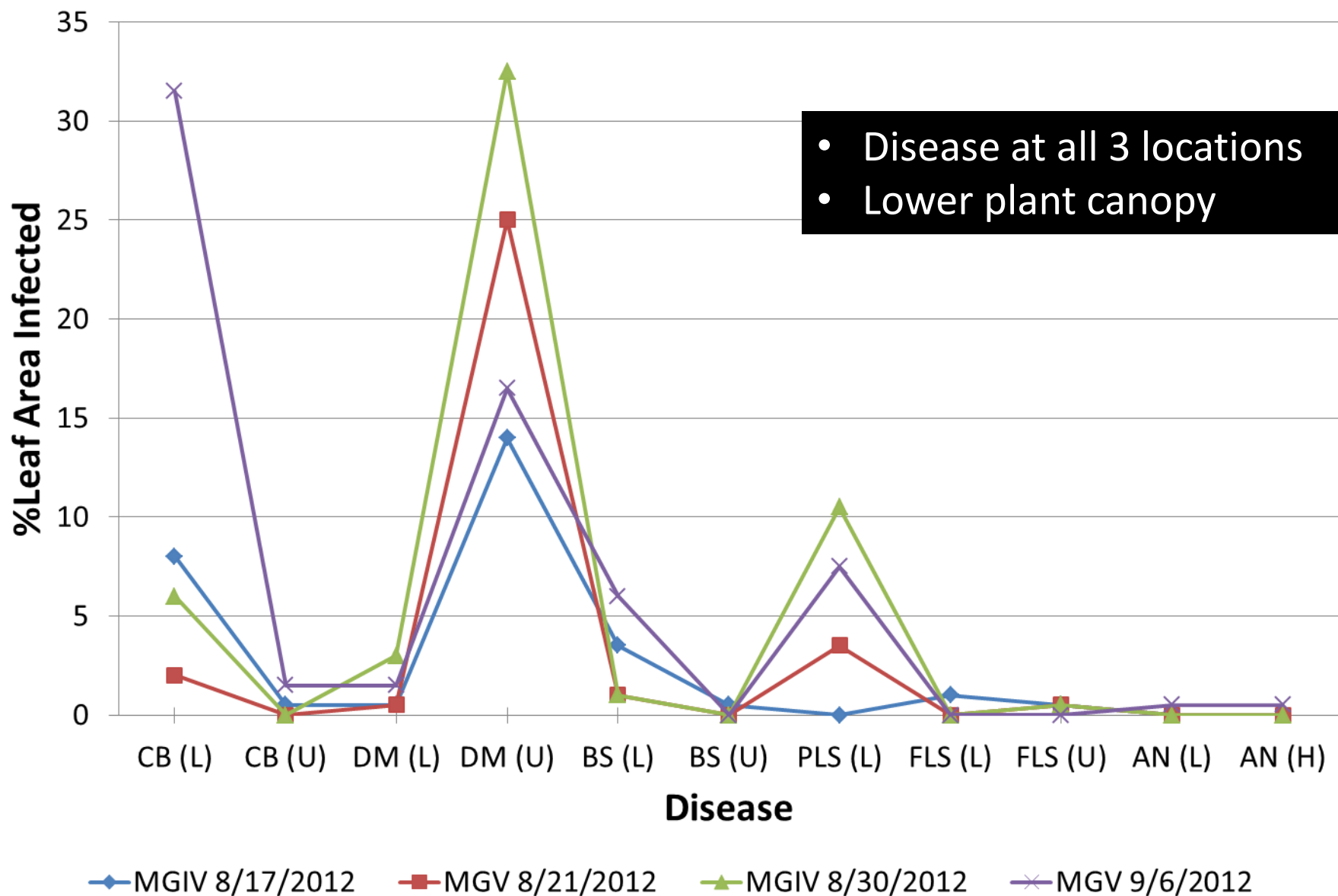
MGIV & V Disease Incidence at Mt. Holly, VA



MGIV & V Disease Incidence at Painter, VA



MGIV & V Disease Incidence at Suffolk, VA



Seed Yield MGIV Results

Source	Seed Yield		
	Mt. Holly	Painter	Suffolk
	-----Pr > F-----		
Cultivar (CV)	0.4626 [†]	0.0038	<.0001
Fung. app timing (FT)	0.4708	0.0209	<.0001
CV*FT	0.8023	0.9717	0.1919

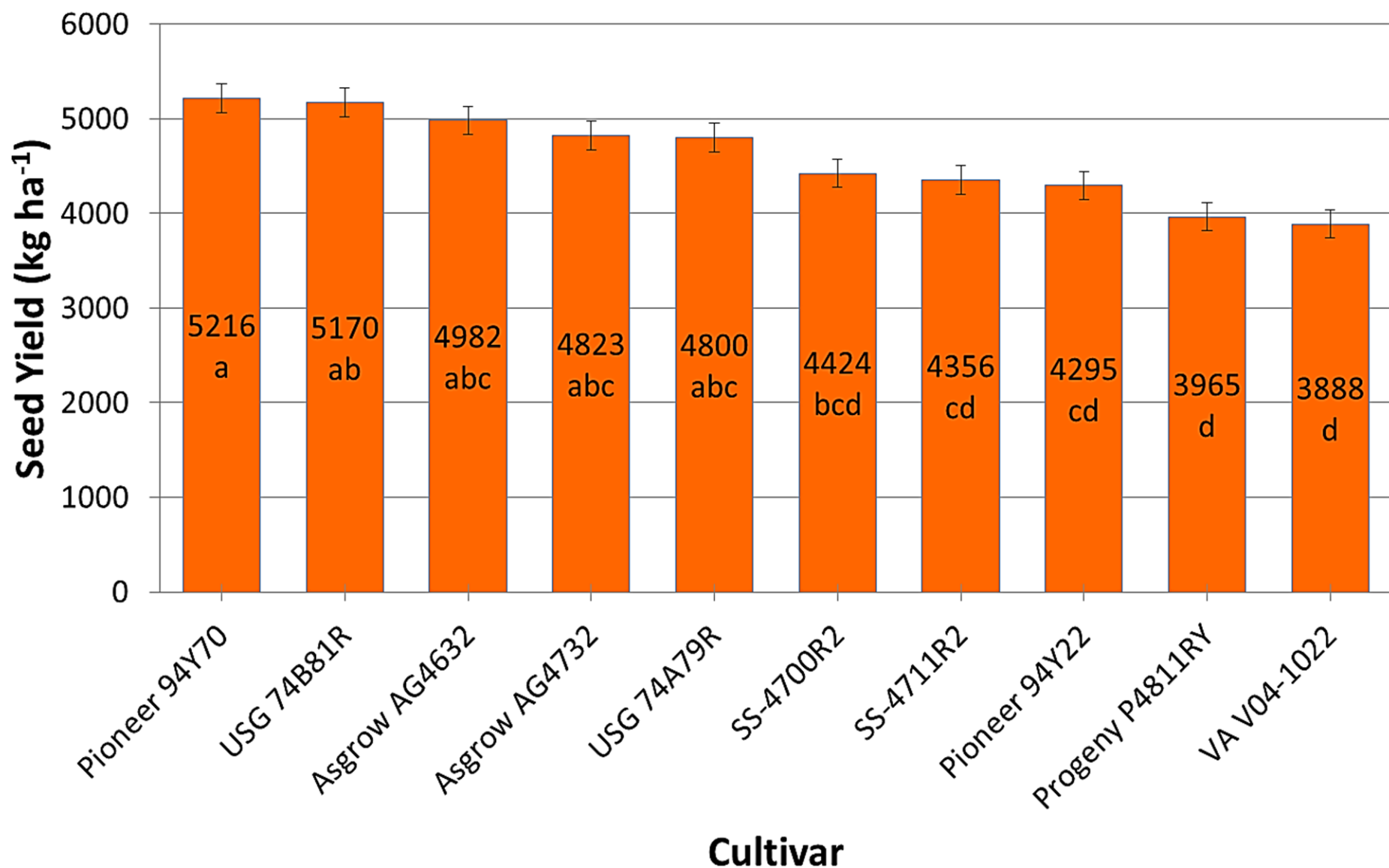
† P = 0.05 level of significance. A P value of < 0.05 indicated significant effect or interaction.

Mt. Holly

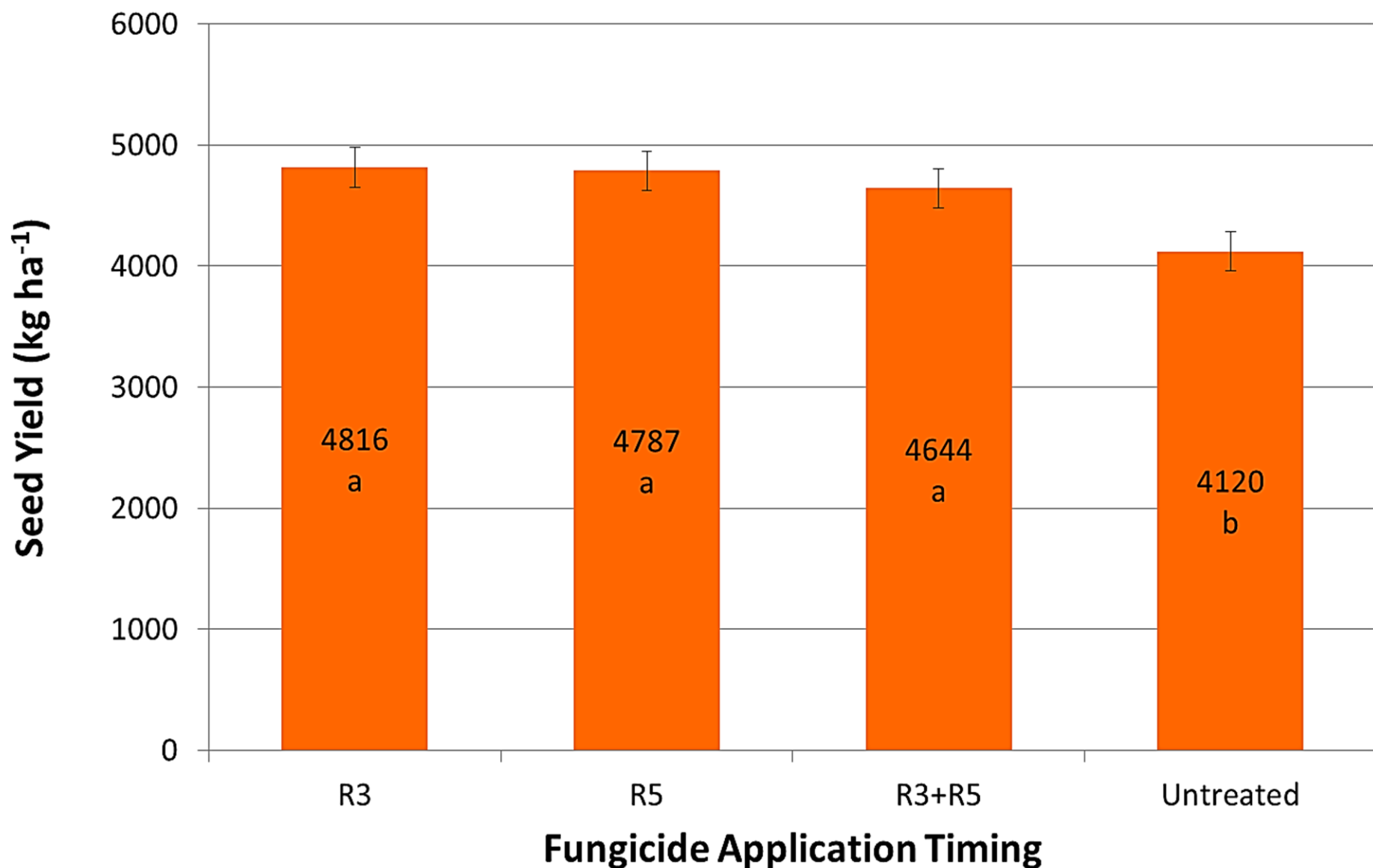


MGIV Painter Seed Yield: Cultivar

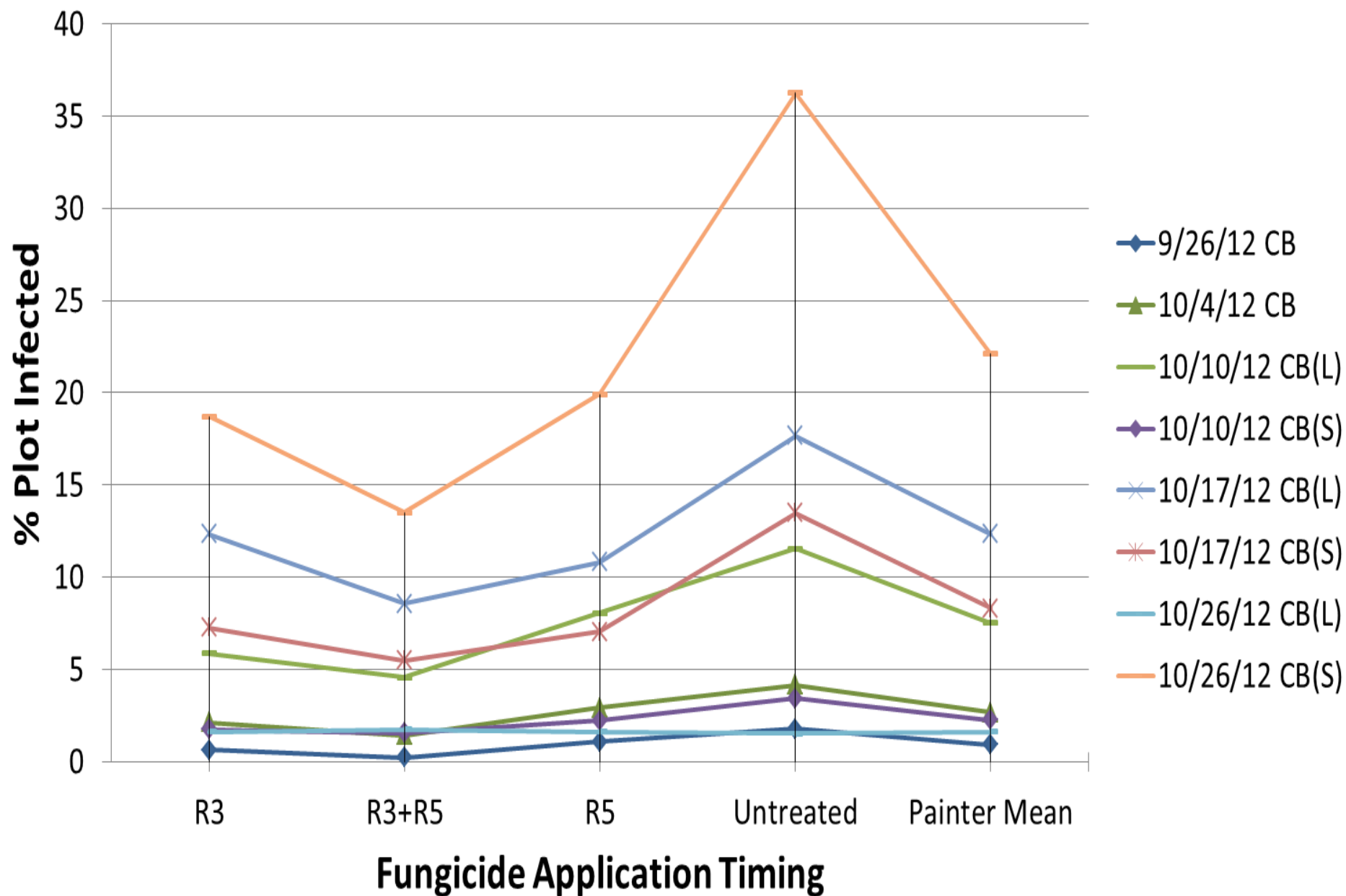
(P=0.0038)(LSD=780)



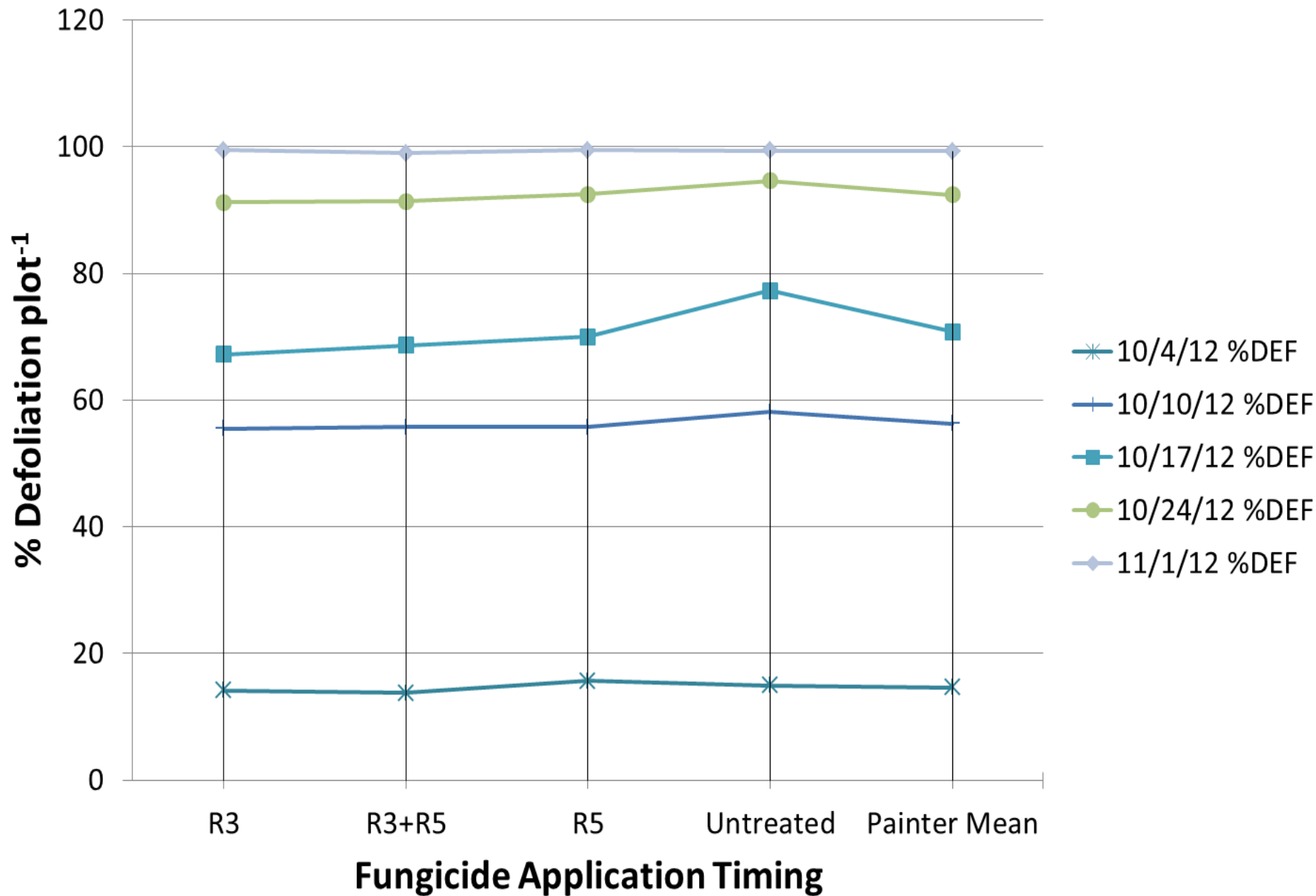
MGIV Painter Seed Yield: Fung. App. Timing (P=0.0209)(LSD=493)



MGIV Cercospora Blight Ratings Painter, VA 2012

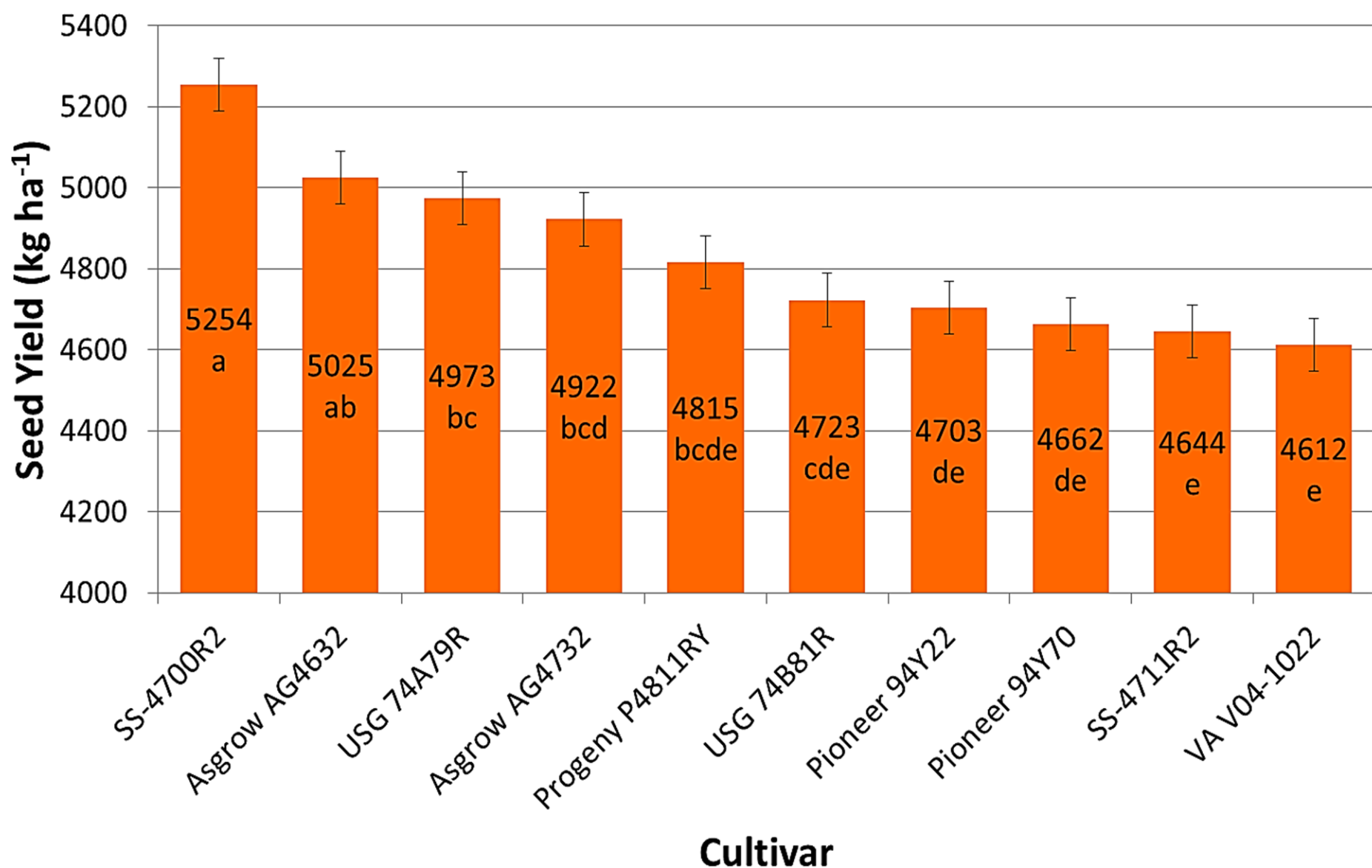


MGIV Defoliation Ratings Painter, VA 2012

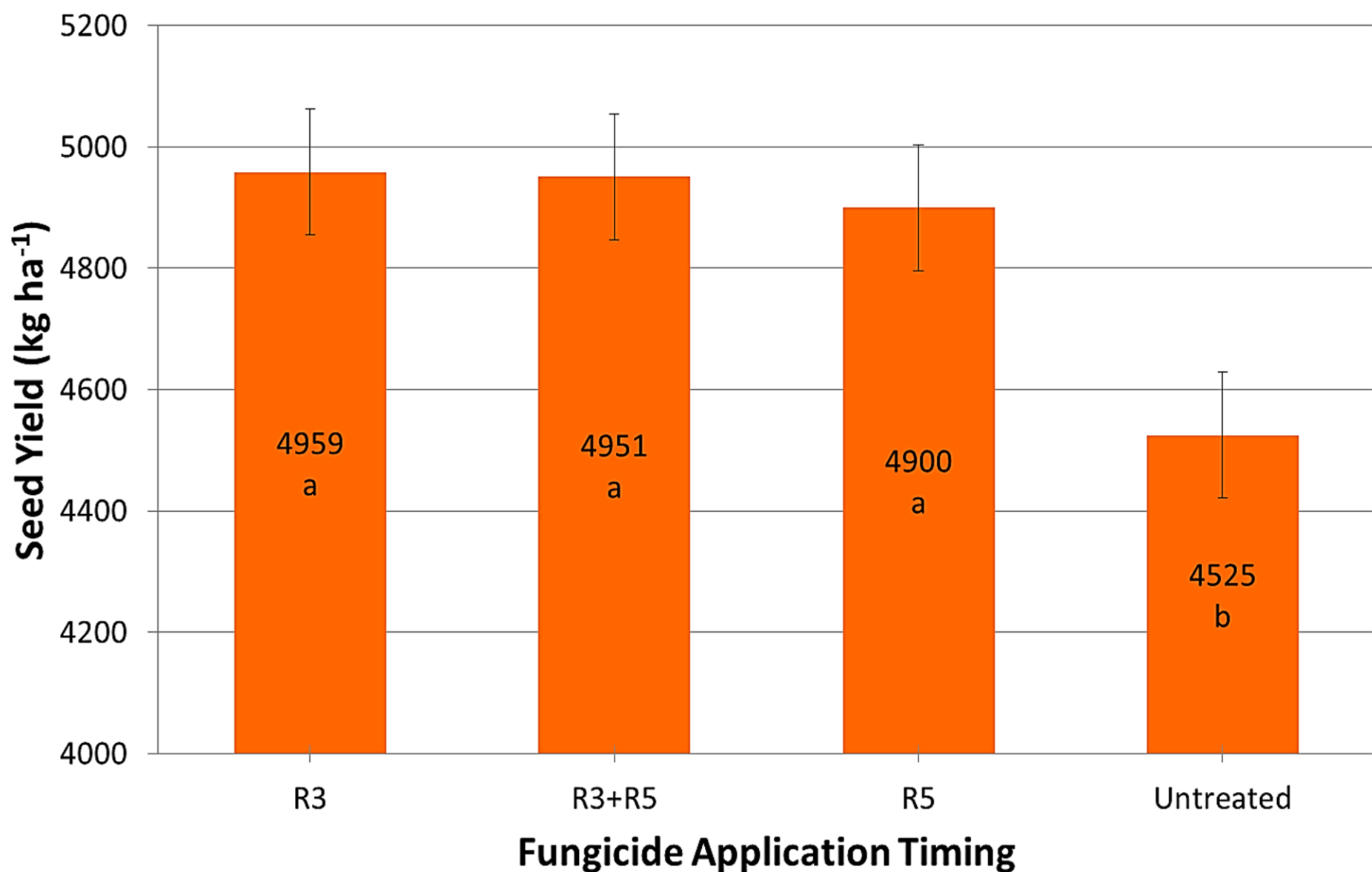


MGIV Suffolk Seed Yield: Cultivar

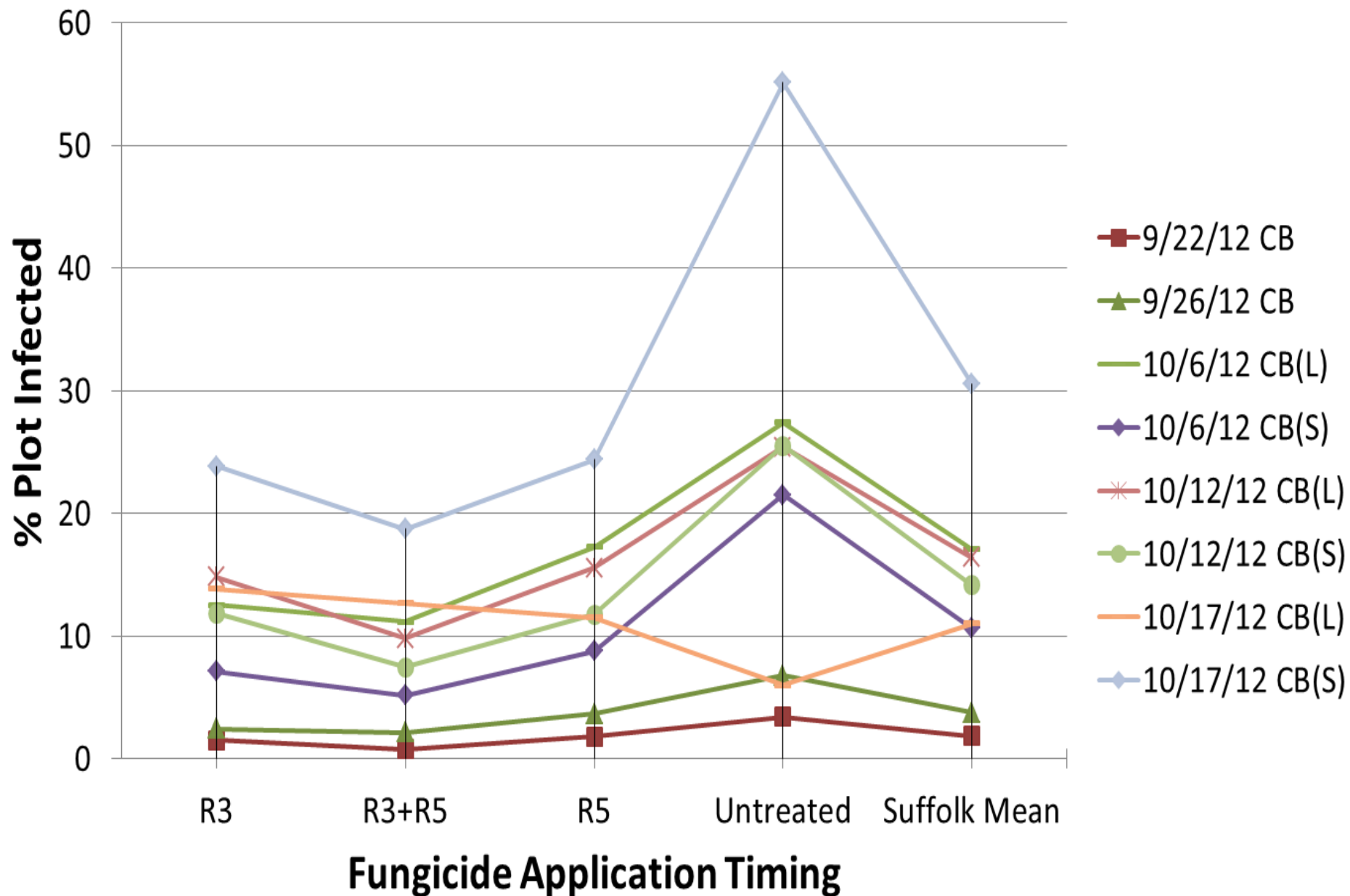
($P < .0001$)(LSD=268)



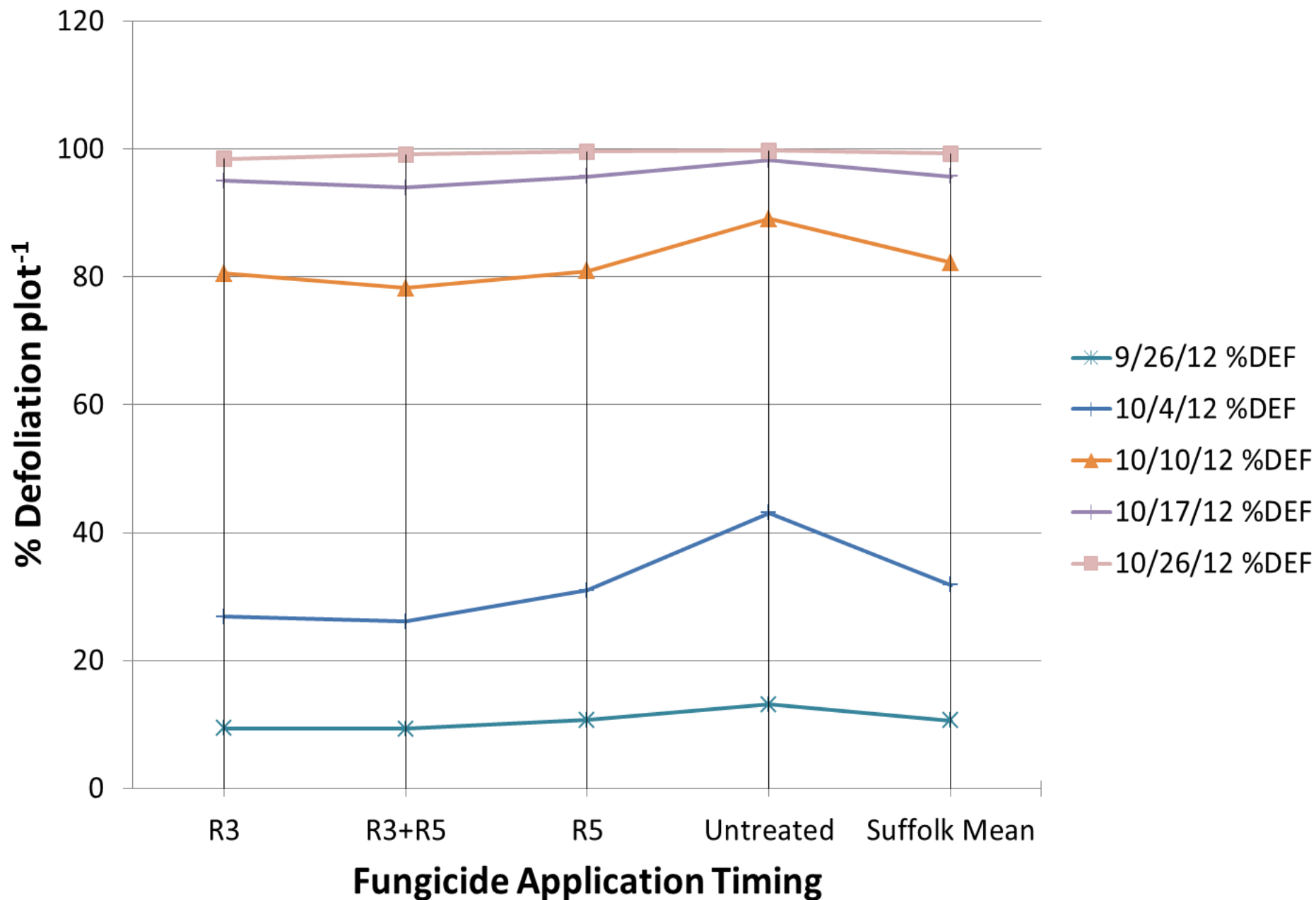
MGIV Suffolk Seed Yield: Fung. App. Timing ($P < .0001$)(LSD=169)



MGIV Cercospora Blight Ratings Suffolk, VA 2012



MGIV Defoliation Ratings Suffolk, VA 2012

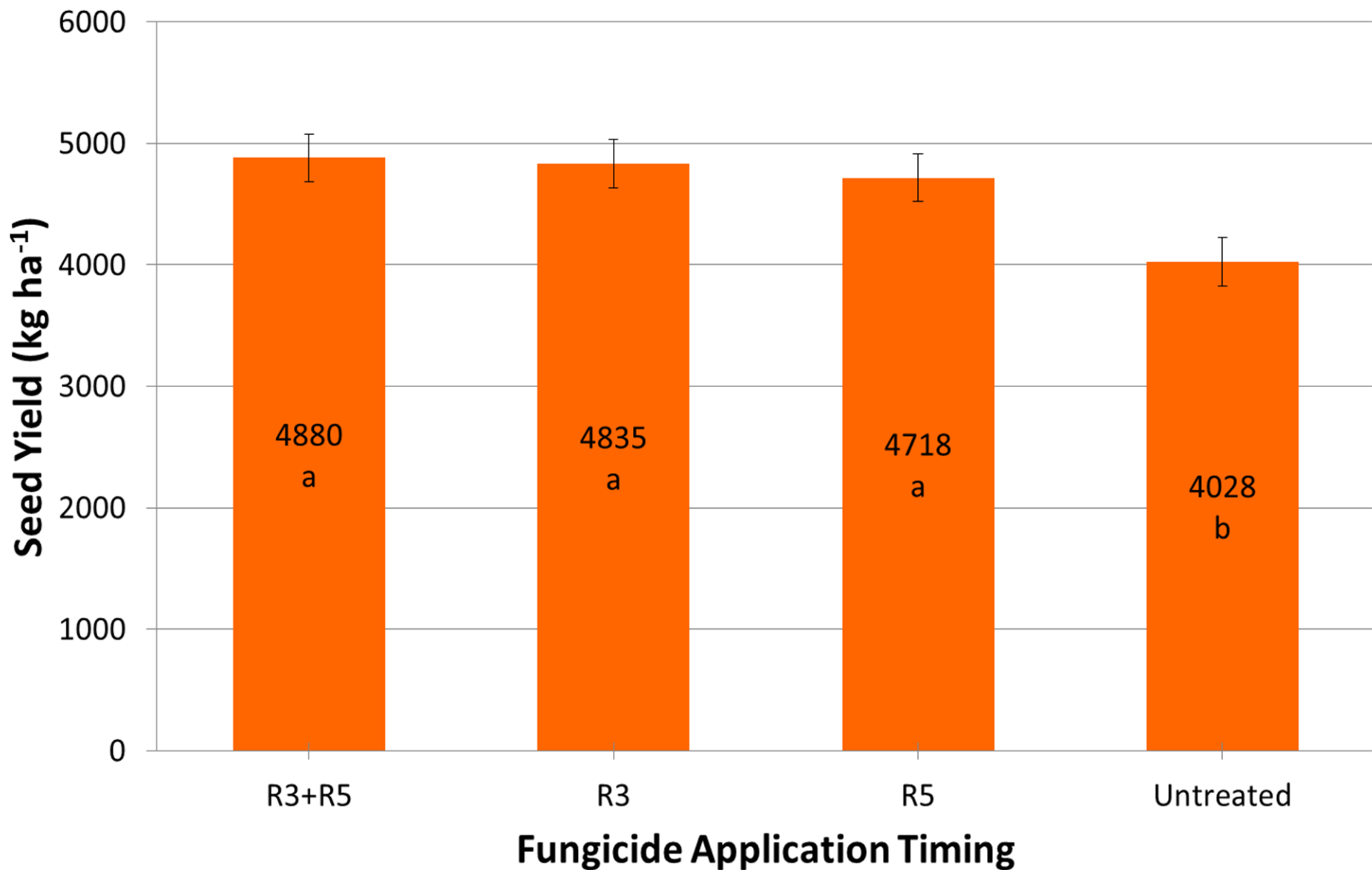


Seed Yield MGV Results

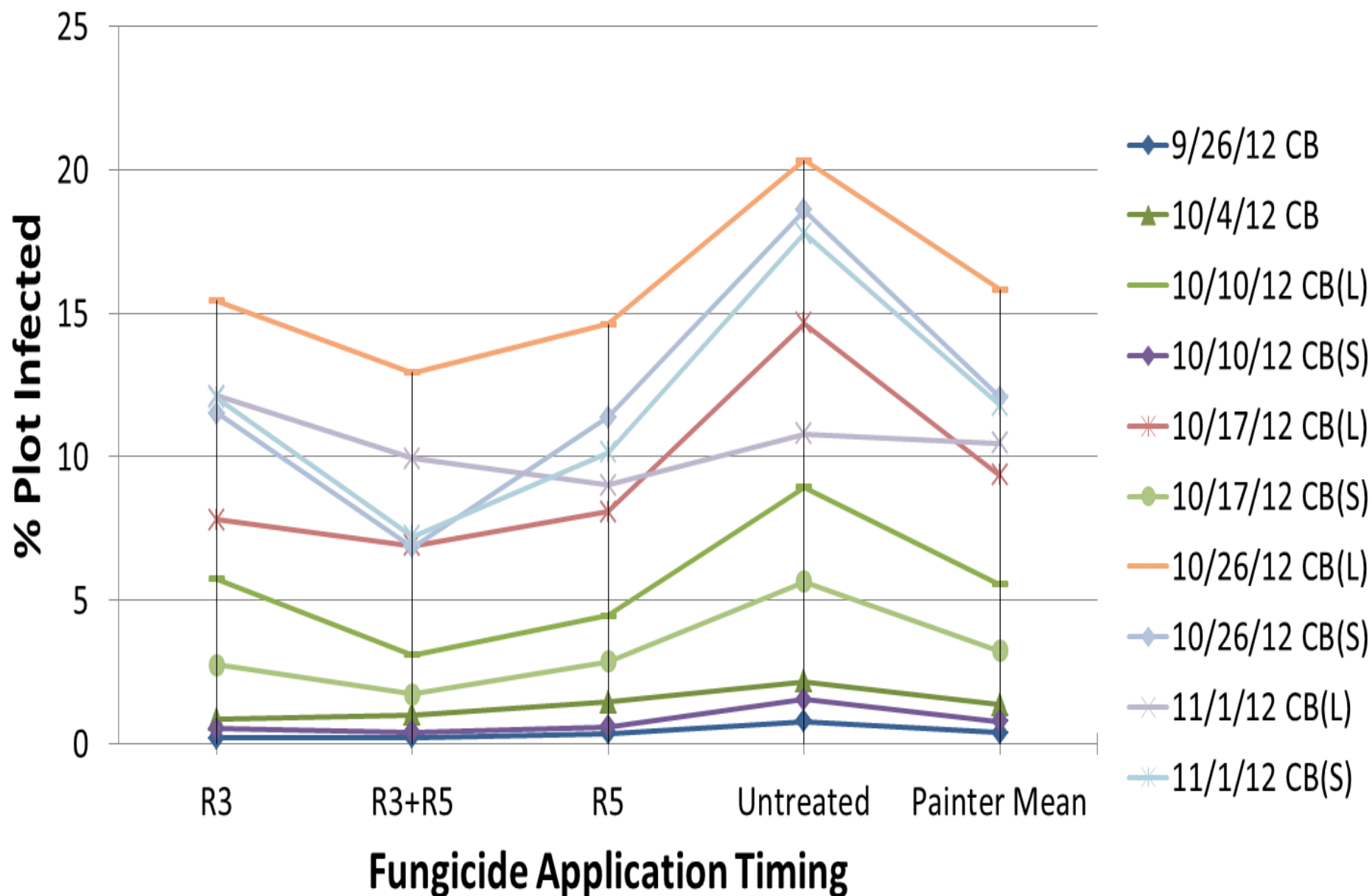
Source	Seed Yield		
	Mt. Holly	Painter	Suffolk
	-----Pr > F-----		
Cultivar (CV)	0.3694 [†]	0.1925	0.0004
Fung. app timing (FT)	0.7426	<.0001	0.0427
CV*FT	0.9990	0.8624	0.9117

† P = 0.05 level of significance. A P value of < 0.05 indicated significant effect or interaction.

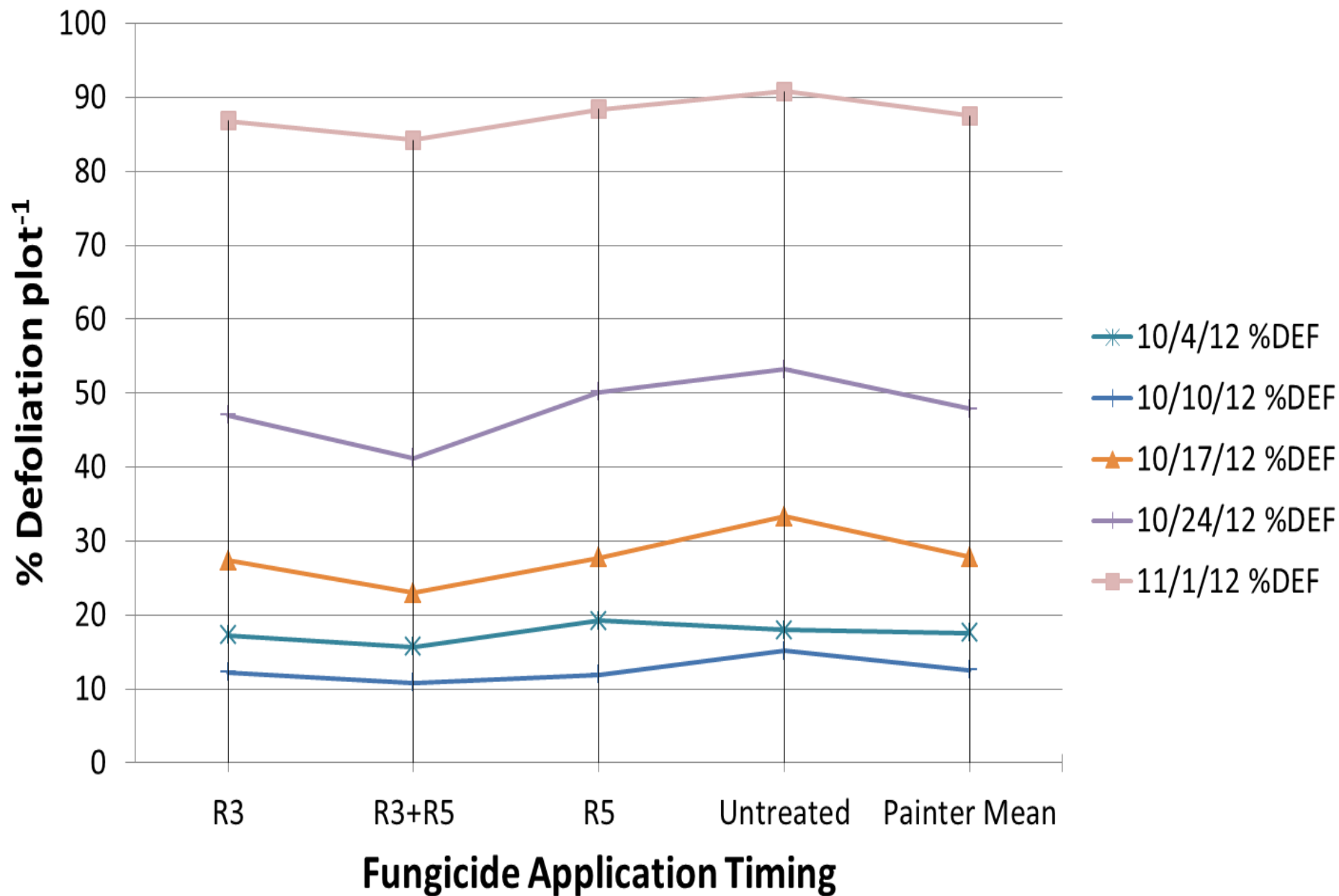
MGV Painter Seed Yield: Fung. App. Timing ($P < .0001$)(LSD=389)



MGV Cercospora Blight Ratings Painter, VA 2012

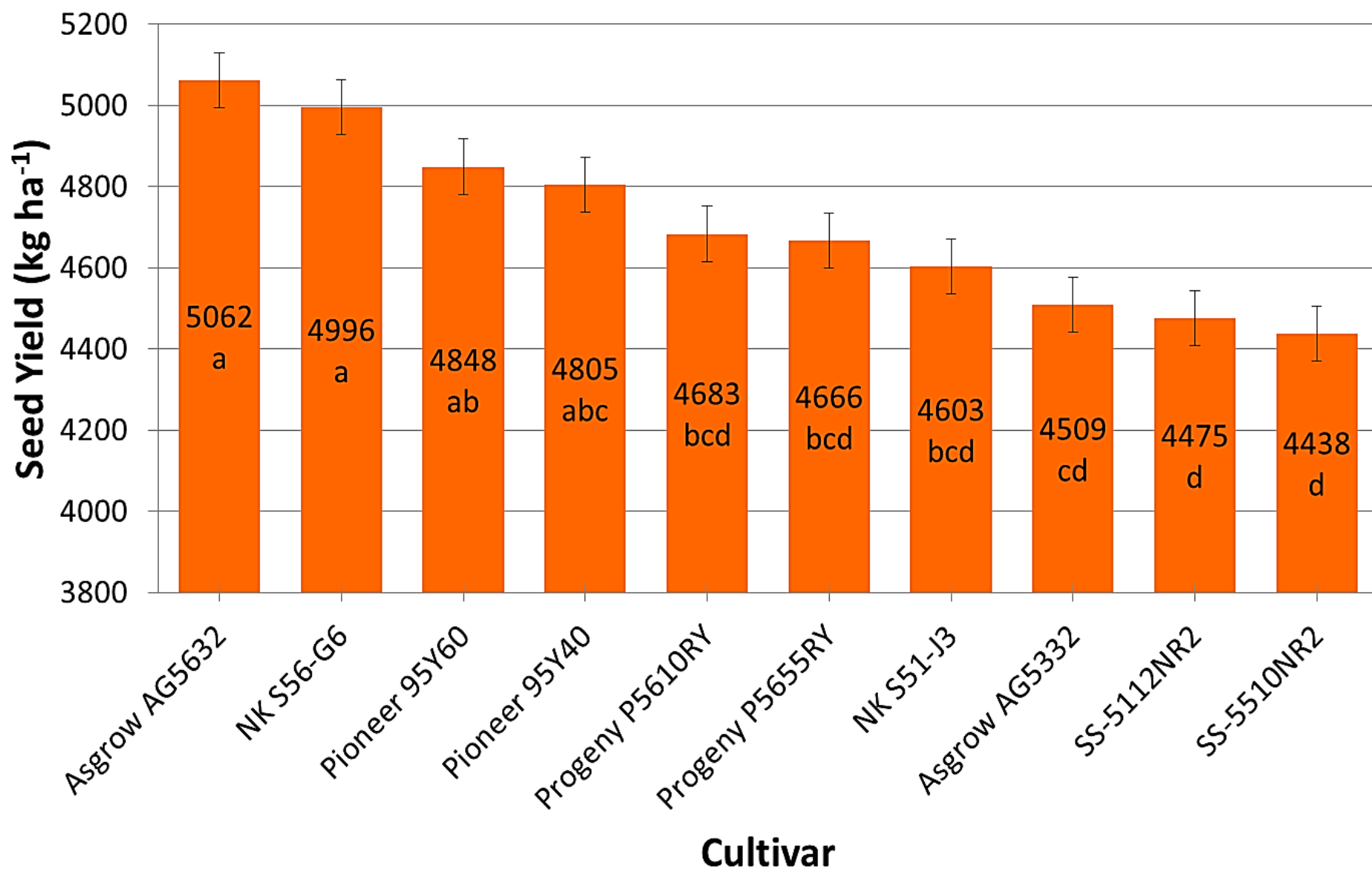


MGV Defoliation Ratings Painter, VA 2012

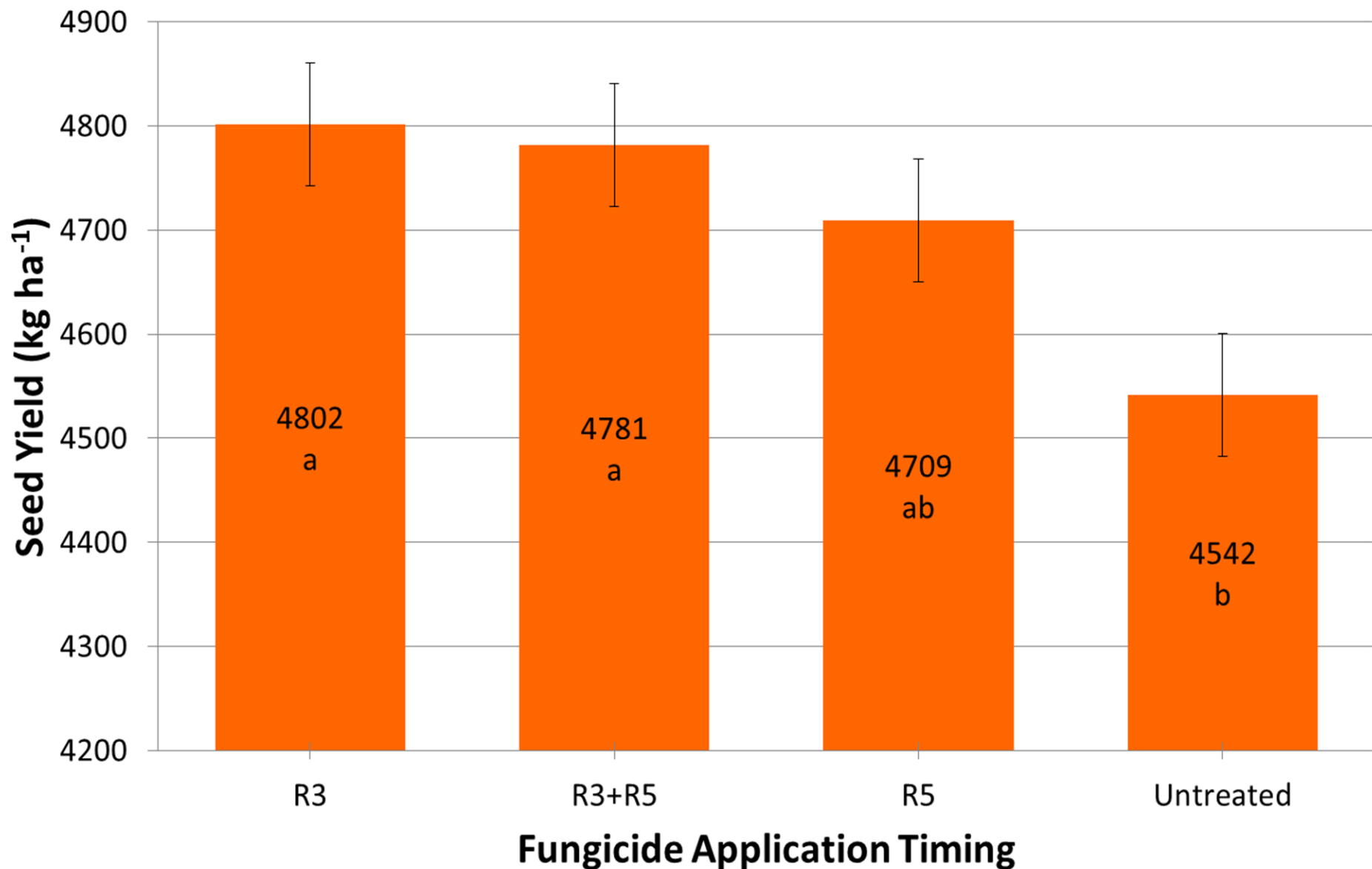


MGV Suffolk Seed Yield: Cultivar

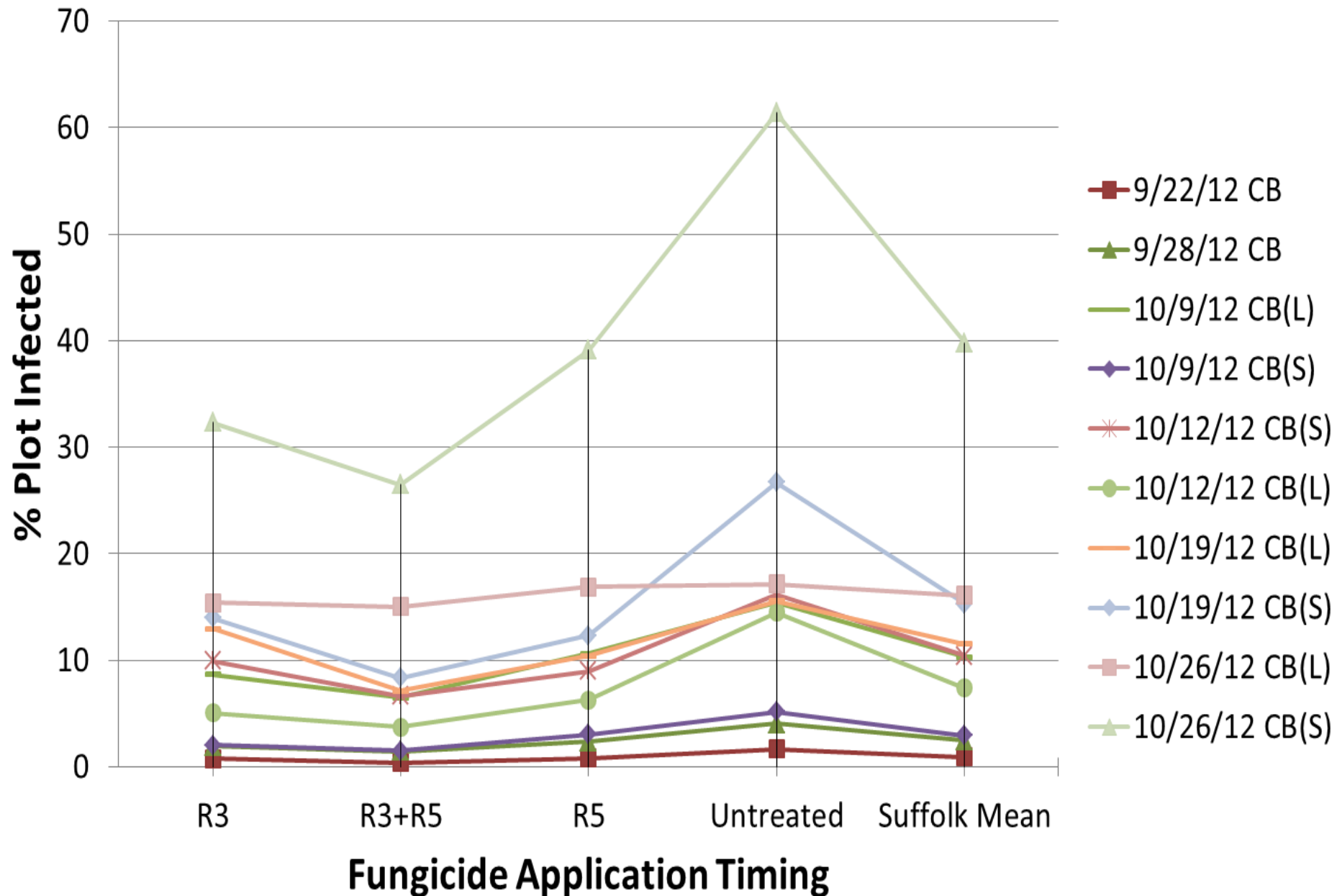
(P=0.0004)(LSD=312)



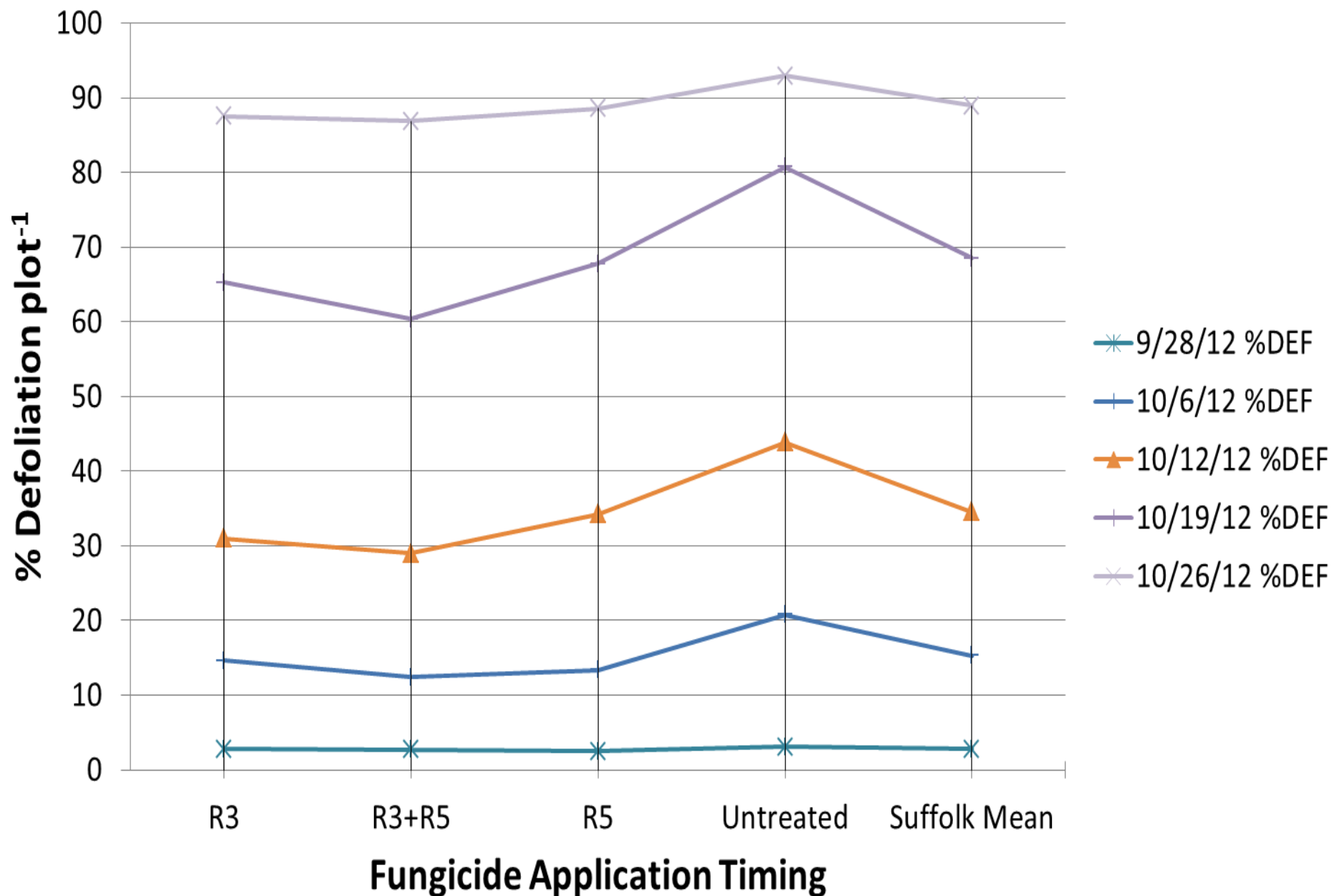
MGV Suffolk Seed Yield: Fung. App. Timing ($P=0.0427$)(LSD=197)



MGV Cercospora Blight Ratings Suffolk, VA 2012



MGV Defoliation Ratings Suffolk, VA 2012



Conclusion: Mt. Holly

- Disease incidence: CB & DM present at R5 (MGIV) and R5.5 (MGV)
- % Defoliation:
 - MGIV = Untreated > all other treatments
 - MGV = Mixed results, R3+R5 = lowest amount
- No seed yield significance
- Drought conditions limited soybean growth & development & masked any cultivar or fungicide application effects on seed yield

Conclusion: Painter

- Disease incidence: CB levels elevated in both MGIV & V late season (MGIV = R5.5; MGIV = 4.25)
- MGIV
 - CB ratings: Untreated (36%) > R3≈R5 (19%) > R3+R5 (13%)
 - % Defoliation: Untreated > all treatments (slightly)
 - Cultivar differences in seed yield
 - Fungicide application (all 3 timings) increased seed yield compared to untreated; untreated decreased yield by 11%
- MGIV
 - CB ratings: Untreated (21%) > R3 (16%) > R5 (14%) > R3+R5 (13%)
 - % Defoliation: Untreated > R3+R5 (lowest)
 - Fungicide application (all 3 timings) increased seed yield compared to untreated; untreated decreased yield by 15%

Conclusion: Suffolk

- Disease incidence: initial CB infection high for MGIV (R3.5); MGIV peaked high CB incidence at R5
- MGIV
 - CB ratings: Untreated (55%) > R3≈R5 (24%) > R3+R5 (18%)
 - % Defoliation: Untreated > than all other treatments
 - Cultivar differences in seed yield
 - Fungicide application (all 3 timings) increased seed yield compared to untreated; untreated decreased yield by 8%
- MGIV
 - CB ratings: Untreated (62%) > R5 (39%) > R3 (32%) > R3+R5 (26%)
 - % Defoliation: Untreated > R5 > R3≈R3+R5
 - Cultivar differences in seed yield
 - Untreated decreased seed yield by 5% compared to R3 and R3+R5

Summary

- CB Ratings (MGIV & V): Suffolk > Painter > Mt. Holly
- MGIV % Defoliation:
 - Untreated = highest defoliation (all 3 locations)
- MGIV % Defoliation:
 - Untreated = highest defoliation (all 3 locations), BUT....
 - Painter: R3+R5 = limited defoliation
 - Suffolk: R3 & R3+R5 = similarly limited defoliation
- Seed Yield:
 - Mt. Holly = Drought conditions masked cultivar/fungicide application
 - MGIV Painter & Suffolk, cultivar differences; untreated decreased yield
 - MGIV Painter = Fungicide effect on yield greater compared to Suffolk
 - MGIV Suffolk = Cultivar differences , lower fungicide yield effect compared to Painter

Future Research Initiatives

- Field scouting importance
 - Growth stages?
 - Disease severity?
 - Weather patterns?
 - Application cost?
 - Soybean market value?
- Next step
 - Correlate seed yield with disease ratings/NDVI data/% defoliation
 - Analyze and summarize 100 seed weight
 - Repeat studies in 2013 growing season



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