UNIVERSITY OF DELAWARE | Cooperative Extension
COLLEGE OF AGRICULTURE & NATURAL RESOURCES

Applied Research Results on Field Crop Disease Control

2014

Nathan Kleczewski Ph.D.

Extension Plant Pathology Specialist

University of Delaware

Department of Plant and Soil Sciences

Newark, Delaware 19716

ACKNOWLEDGMENTS

The author wishes to thank the Carvel Research and Education Center and the Wye Research and Education Center for resources needed to support this applied research program. A special thanks to Brian Hearn, Vic Greene, Joseph Streett and Don Murphy for assisting with plot maintenance and harvest and to Bob Unitowski for conducting the wheat and soybean variety trials. Thanks to Joanne Whalen and Bill Cissel for assistance with setting up soybean surveys and Steve Rozell, Michael Cannon, Patti Kunkel, Seth Malusa, Ruth Kleczewski, and Phillip Sylvester for technical assistance. The assistance of Dr. Arv Grybauskas, Dr. Alyssa Collins, and Robert Mulrooney was also greatly appreciated. Thanks to Nancy Gregory and Dr. Tom Evans for allowing us to utilize lab space to produce inoculum and isolate pathogens from plant tissues. Lastly recognition is extended to the multiple groups and organizations that helped with this program through funding or providing products essential to research trials.

LIST OF CONTRIBUTORS

<u>Commodity Groups and Organizations</u>

Delaware Soybean Board

Delaware Crop Improvement Board

United States Wheat and Barley Scab Initiative

<u>Private Companies</u>

BASF Corp., Raleigh, NC

Bayer CropScience, Kansas City, MO

Dupont Crop Protection, Wilmington, DE

FMC Corp. Philadelphia, PA

Gowan Co., Yuma AZ

Pioneer Hi-Bred New Holland, PA

Syngenta Crop Protection, Wilmington, DE

Table of Contents

INTRODUCTION

From Kevin Binson Delaware State Climatologist.

Delaware's 2014 climate was characterized by slightly cooler than normal temperatures and near normal precipitation values.

Annual Temperature

Statewide mean annual temperature in 2014 was 54.8° F according to preliminary data from the National Climatic Data Center (NCDC). This was 0.6° F below the 1981-2010 normal of 55.4° F and was the coolest year in Delaware since 2003. Monthly temperatures varied greatly throughout the year. The first four months of 2014 saw much below normal temperatures accompanied by heavy snowfall across the State. Although late spring and early summer saw a return to above normal temperatures, the late summer climate was cooler than normal, a welcome respite from the summer heat for many residents. The year ended with a return to warmth in three of the last four months.

Annual Precipitation

Statewide precipitation in 2014 averaged 43.49 inches, 0.84 inches below the 1981-2010 mean of 44.33 inches. Monthly precipitation anomalies varied between positive and negative throughout the year, with six months of above normal and six months of below normal precipitation. None of the monthly precipitation anomalies were large, leading to the near normal annual total.

Statewide Spatial Averages

According to data from the Delaware Environmental Observing System (DEOS; deos.udel.edu), mean annual temperatures were below normal across the entire State with the largest negative anomalies found in coastal Sussex County.

Precipitation across the region varied substantially in 2014, ranging from just under 39 inches to greater than 50 inches across the region. Delaware experienced its coolest summer since the 2000 season. The Statewide mean summer temperature of 73.7°F was 0.8°F below the 1981-2010 normal of 74.5°F. The cooler than normal summer conditions were the fourth season in a row with below normal temperatures dating back to the autumn season of 2013.

Cool summer temperatures were accompanied by near normal precipitation across the state during the summer season. The statewide mean precipitation of 12.81" was 0.81" above the 1981-2010 normal of 12.00", and was the 4th year in a row with near or above normal summer precipitation. Although above normal, 2014 summer precipitation was 9.32" less than 2013, which stands as the wettest summer on record for Delaware. Data obtained from http://climate.udel.edu/, accessed 1/23/2015.

The research described in this book was designed to updated information on diseases and disease management to clientele in Delaware and Maryland. Commercial products are named for informational purposes only. Delaware Cooperative Extension and University of Delaware, do not advocate or warrant products named nor do they intend or imply discrimination against those not named. **Please contact Dr. Nathan Kleczewski for permission to use any content presented in this booklet.**

Small Grains

Wheat yields averaged 72 bu/A on 75,000 harvested acres. Overall production was estimated at 5,400,000 bu. Leaf blotches, predominantly tan spot, were the most common diseases encountered in Delaware. Incidence of powdery mildew and rusts was minimal in 2014. Fusarium head blight was present at low levels. Viral diseases were largely absent.

Barley yields averaged 86 bu/A on 31,000 harvested acres. Overall production was estimated at 2,666,000 bu. Net blotch was present at low levels, as was powdery mildew. Vomitoxin infested grain was reported from some fields, indicating low levels of Fusarium head blight.

Wheat Disease Evaluations-2014

Disease severity was evaluated the small grains variety trial located in Marydel, Delaware. The variety trial tests the adaptability of winter wheat varieties to Delaware growing conditions and susceptibility to common diseases in the region. Several pathogens common to the region were detected on leaves and heads, including leaf rust, leaf blotch, powdery mildew, and Fusarium head blight. Only leaf blotch was dispersed uniformly and at levels at the flag leaf high enough to rate. Although moderate levels of head scab were present at the site the disease was not rated due to variation in flowering date, which likely results in disease escape and can impact apparent resistance to this disease.

The disease ratings were made on June 12th 2013. The stage of development was mid to late-dough. Plots were identified with numbers and not variety identifications. There were three plots per variety. Ten flag leaves per plot were randomly sampled and rated for percent disease using standard disease severity scales (C. James, 1971. A Manual of Assessment Keys for Plant Diseases. The American Phytopathological Society. St. Paul, MN). F-1 leaves were senescing and therefore not rated. The average area of diseased leaves (severity) was calculated for each plot by averaging the severity ratings for the ten leaves sampled. Data were log transformed for normality and statistically analyzed using JMP Pro v. 11 (SAS Institute Inc.). Means were separated using Fishers Protected LSD (α=0.10). Data are provided in Table 1.

Across Delaware, leaf blotch and powdery mildew were prevalent. Due to a cold, penetrating winter and a cool spring, powdery mildew and leaf blotches were not prevalent until after Feekes 8/9 in many fields. Leaf rust was not detected until after flowering and was not an issue in 2014. Stagonospora was moderate to severe in some unsprayed fields in parts of Delaware. Fusarium head blight/scab was prevalent, but low in incidence and severity. Most fields were well below 2% field index, a measure of bleaching at the field level. Tan spot was also present in many fields, but not found at the variety trial in Marydel, Delaware.

Source	Variety	Average % Severity	Rating (1-5)	Source	Variety	Average % Severity	Rating (1-5)
Ga Exp	Ga-041239-11E44	0.4 A	1				
GroMark	FSX 855	0.4 A	1	DynaGro	9223	2.5 ABCD	2
DynaGro	Shirley	0.4 A	1	MBX	14-K-297	2.5 ABCD	2
Agrimaxx	Exp. 1465	0.7 AB	1	DynaGro	WX13652	2.5 ABCD	2
GroMark	FSX 851	0.7 AB	1	Southern States	5205	2.6 ABCD	2
Unisouth	3612	0.7 AB	1	Unisouth	3201	3.1 ABCD	3
Agrimaxx	Exp. 1444	0.8 AB	1	GroMark	FSX 850	3.3 ABCD	3
GroMark	FSX 853	0.8 AB	1	Ga Exp	Ga-041293-11LE37	3.3 ABCD	3
Syngenta	SY474	1.0 ABC	2	GroMark	FSX 888	3.4 ABCD	3
GroMark	FS 820	1.0 ABC	2	MD Exp.	MD04W249-11-7	3.5 ABCD	3
MD Exp.	MD05W56-12-5	1.0 ABC	2	Southern States	8870	3.5 ABCD	3
GroMark	FSX 854	1.1 ABC	2	Southern Harvest	3200	3.8 ABCD	3
Mercer Brand	12-V-251	1.1 ABCD	2	GroMark	FS 815	3.9 ABCD	3
Public	Cheaspeake	1.2 ABCD	2	Southern States	8340	4.1 ABCD	3
Southern States	8415	1.2 ABCD	2	Unisouth	3315	4.3 ABCD	3
Unisouth	3404	1.5 ABCD	2	GroMark	FSX 856	4.4 ABCD	3
DynaGro	WX13622	1.5 ABCD	2	Southern States	520	4.4 ABCD	3
Mercer Brand	12-W-270	1.6 ABCD	2	DynaGro	Yorktown	4.7 ABCD	3
Agrimaxx	415	1.6 ABCD	2	MD Exp.	MD04W249-11-12	4.7 ABCD	3
Unisouth	3523	1.8 ABCD	2	Syngenta	SY007	4.9 ABCD	3
Southern States	8360	1.8 ABCD	2	DynaGro	9171	5.2 ABCD	3
Agrimaxx	427	2.0 ABCD	2	Agrimaxx	Exp. 413	5.3 ABCD	3
Ga Exp	Ga-04434-11E44	2.0 ABCD	2	Agrimaxx	434	5.6 ABCD	3
MBX	14-S-210	2.2 ABCD	2	Southern States	8412	6.1 ABCD	4
Unisouth	3993	2.2 ABCD	2	Featherstone	73	6.4 ABCD	4
Mercer Brand	12-W-296	2.3 ABCD	2	GroMark	FSX 852	6.6 BCD	4
DynaGro	9012	2.3 ABCD	2	Mercer Brand	12-V-258	6.7 BCD	4
Public	Jamestown	2.3 ABCD	2	Southern States	8500	8.1 BCD	4
Syngenta	SY1526	2.4 ABCD	2	Unisouth	3013	9.8 D	5

Table 1. Ratings of 57 Varieties included in the University of Delaware wheat variety trials in 2014. The site located in Marydel, Delaware was used in this test. Ten leaves were rated for disease severity per plot. Each variety was replicated three times. The average area of diseased leaves (severity) was calculated for each plot by averaging the severity ratings for the ten leaves sampled. Data were log transformed for normality and statistically analyzed using JMP Pro v.11 (SAS Institute Inc.). **Different letters indicate significant disease differences using Fishers Protected LSD (α= 0.10).** Ratings are provided on a 1-5 scale with 1= high resistance and 5=low resistance to Stagonospora leaf and glume blotch.

Host (*Triticum aestivum* Dynagro 'Shirley')
Fusarium head blight; *Fusarium graminearum*

N.M. Kleczewski
University of Delaware
Department of Plant and Soil Sciences
Newark, DE 19716

Effect of Prosaro and *F. graminearum* application timing on Fusarium head blight in Delaware, 2014.

The trial was conducted at the Middletown Demonstration and Research Farm located in Middletown, DE. The wheat variety Dynagro 'Shirley' was planted at 1.7 x 10^6 seeds per acre on 20 Oct 13 in rows 7.5-in apart. The previous crop was corn, disked before planting. Experimental units were 5 x 20 ft. There were two untreated buffer rows between adjacent plots and 5-ft of untreated wheat at plot ends. Fertilization and weed management practices was applied following University of Delaware Cooperative Extension recommendations. The experimental design was a completely randomized design with 4 treatment replications. Two treatments, Prosaro timing (untreated, Feekes (FGS) 10.5, FGS 10.5.1, and FGS 10.5.1+5 days) were crossed with *F. graminiarum* (FHB) inoculation timing (FGS 10.5.1 and FGS 10.5.1+10 days). Fungicide applications were applied with a CO_2 pressurized backpack sprayer with three Teejet 8002 flat fan nozzles spaced 20-in apart on an offset handheld boom. Applications were made at 35 psi at a pace to deliver 20 gal/A of spray solution. Treatments were applied at 18 May, 21 May and 26 May and 26 May at FGS 10.5, 10.5.1, 10.5.1+5, and 10.5.1+10, respectively. Plots were harvested on 8 Jul and a 500 g subsample of grain harvested from each plot was evaluated for deoxynivalenol (DON). Data were analyzed by ANOVA, and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons. Yields were calculated based on a 60 lb bushel weight and adjusted to 13.5% moisture.

Although not rated, head blight severity was moderate at the site. No effects of FHB timing or interactions were detected and only main effects of Prosaro timing are presented. Prosaro significantly reduced DON relative to untreated controls at all timings tested and there was no difference between application timing and DON suppression. In addition, yield and test weights were significantly increased for all Prosaro treatments regardless of timing.

Treatment[z], Rate/A	Application stage (FGS)	DON ppm[y]	Test weight	Yield (bu/A)
Non-treated check	-	3.2 a	55.7 a	53.6 a
Prosaro 421 SC 6.5 fl oz	10.5	1.2 b	59.4 b	69.7 b
Prosaro 421 SC 6.5 fl oz	10.5.1	0.9 b	59.2 b	67.0 b
Prosaro 421 SC 6.5 fl oz	10.5.1+5	1.3 b	59.2 b	63.7 b
	P(F)	0.05	0.001	0.01
	R^2	0.619	0.730	0.664

[z] All products were applied with NIS 0.125% (v/v)

[y] Column numbers followed by the same letter are not significantly different at *P*=0.05 as determined by Fisher's LSD [z]

Host (*Triticum aestivum* Agripro 'Oakes')
Tan Spot; *Pyrenophora tritici-repentis*
Powdery mildew; *Erysiphe graminis*

N.M. Kleczewski
University of Delaware
Department of Plant and Soil Sciences
Newark, DE 19716

Effect of foliar fungicides and timings on powdery mildew and tan spot in Maryland, 2014.

The trial was conducted at the Wye Research and Education Center near Queenstown, MD. The wheat variety Agripro 'Oakes' was planted at 1.7 × 10^6 seeds per acre on 28 Oct 13 in rows 7.5-in apart. The previous crop was corn, vertically tilled before planting. Experimental units were 5 × 38 ft. There were two untreated buffer rows between adjacent plots and 7 ft of untreated wheat at plot ends. Nitrogen (UAN) was applied at 40 lb/A on 12 Mar and 11 Apr. Standard weed and insect management procedures were followed. The experimental design was a randomized complete block with 4 replications. Fungicide applications were applied with a CO_2 pressurized backpack sprayer with three TeeJet 8002 flat fan nozzles spaced 20-in apart on an offset handheld boom. Applications were made at 35 psi at a pace to deliver 20 gal/A of spray solution, and all treatments received 0.125% NIS. Treatments were applied on 9 Apr, 9 May, and 20 May at Feekes' growth stage (FGS) 5; FGS 8; and FGS 10.5.1. Disease evaluations were conducted at FGS 11.2 on the flag-1 leaves (powdery mildew) on 5 Jun and the flag leaf (tan spot) on 8 Jun. All disease evaluations were made on 10 randomly selected leaves per plot by visually estimating the percent of diseased leaf area. Plots were harvested on 2 Jul. Data were analyzed by ANOVA, and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons. Powdery mildew and Tan spot severity data were log transformed prior to analysis and presented as untransformed means. Yields were calculated based on a 60 lb bushel weight and adjusted to 13.5% moisture.

Disease pressure was very low likely as a result of a harsh winter in 2013 followed by a cold spring. Low levels of powdery mildew and tan spot were detected on approximately 50% of tillers in untreated plots on May 20 (FGS 10.5.1). Fungicides applied solo at FGS 5 did not reduce tan spot or powdery mildew compared to controls. All fungicides applied as split applications and solo after FGS 8 provided significantly greater suppression of powdery mildew except Prosaro 421 SC 5 fl oz applied solo at FGS 8.

Treatment[z], Rate/A	Application stage	P. mildew (%)[x]	Tan spot (%)	Yield (bu/A)
Non-treated check		1.4 a[*]	2.5 a	73.4
Priaxor 500 SC 2 fl oz	5	1.1 ab	1.8 a	75.2
Quilt Xcel 2.2 SE 7 fl oz	5	0.8 a-d	1.8 a	78.0
Stratego YLD 500 SC 2 fl oz	5	1.2 ab	2.1 a	74.7
TwinLine 210 EC 6 fl oz	5	0.6 b-e	2.0 a	77.7
Quilt Xcel 2.2 SE 7 fl oz FB[y] Quilt Xcel 2.2 SE 10.5 fl oz	5 8	0 g	0.2 d	74.6
Priaxor 500 SC 2 fl oz FB Caramba 90 EC 13.5 fl oz	5 10.5.1	0.5 c-f	0.7 bc	77.5
Stratego YLD 2 fl oz FB Prosaro 421 SC 6.5 fl oz	5 10.5.1	0.5 c-f	0.2 d	73.1
Aproach Prima 280 SC 3.4 fl oz	8	0.1 fg	0.2 d	73.3
Priaxor 500 SC 4 fl oz	8	0.2 e-g	0.3 cd	74.9
Prosaro 421 SC 5 fl oz	8	0.1 ab	1.0 a	78.9
Quilt Xcel 2.2 SE 10.5 fl oz	8	0.1 fg	0.3 cd	74.2
Stratego YLD 500 SC 4 fl oz	8	0.3 d-g	1.0 b	76.5
TwinLine 210 EC 9 fl oz	8	0.3 e-g	0.3 cd	79.7
Caramba 90 EC 13.5 fl oz	10.5.1	0.6 b-e	0.4 cd	73.0
Prosaro 421 SC 6.5 fl oz	10.5.1	0.9 a-c	0.2 d	75.7
	P(F)	0.0001	0.0001	0.9
	R^2	0.633	0.739	0.456

[z] All products with NIS 0.125% (v/v)
[y] FB = followed by
[x] Column numbers followed by the same letter are not significantly different at *P*=0.05 as determined by Fisher's LSD.

Host (*Triticum aestivum* Agripro 'Oakes')
Tan Spot; *Pyrenophora tritici-repentis*
Powdery mildew; *Erysiphe graminis*

N.M. Kleczewski
University of Delaware
Department of Plant and Soil Sciences
Newark, DE 19716

Effect of Palisade and fungicide timings on powdery mildew and tan spot in Maryland, 2014.

The trial was conducted at the Wye Research and Education Center near Queenstown, MD. The wheat variety Agripro Oakes was planted at 1.7 x 10^6 seeds per acre on 28 Oct 13 in rows 7.5-in apart. The previous crop was corn, vertically tilled before planting. Experimental units were 5 x 38 ft. There were two untreated buffer rows between adjacent plots and 7-ft of untreated wheat at plot ends. Nitrogen (UAN) was applied at 40 lb/A on 12 Mar and 11 Apr. Standard weed and insect management procedures were followed. The experimental design was a randomized complete block with 4 replications. Fungicide applications were applied with a CO_2 pressurized backpack sprayer with three Teejet 8002 flat fan nozzles spaced 20-in apart on an offset handheld boom. Applications were made at 35 psi at a pace to deliver 20 gal/A of spray solution, and all treatments received 0.125% NIS. Treatments were applied at 9 Apr, 28,Apr, 9 May, and 20 May at Feekes' growth stage (FGS) 5; FGS 7; FGS 8; and FGS 10.5.1, respectively. Disease evaluations were conducted at FGS 11.2 on the flag-1 leaves (powdery mildew) on 5 Jun and the flag leaf (tan spot) on 8 Jun. All disease evaluations were made on 10 randomly selected leaves per plot by visually estimating the percent of diseased leaf area. Plots were harvested on 2 Jul. Data were analyzed by ANOVA, and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons. Powdery mildew and Tan spot severity data were log transformed prior to analysis and presented as untransformed means. Yields were calculated based on a 60 lb bushel weight and adjusted to 13.5% moisture.

Disease pressure was very low likely as a result of a harsh winter in 2013 followed by a cold spring. Low levels of powdery mildew and tan spot were detected on approximately 50% of tillers in untreated plots on May 20 (FGS 10.5.1). Fungicides applied at solo at FGS 5 did not reduce tan spot or powdery mildew compared to controls. All fungicides applied as split applications and solo after FGS 8 provided significantly greater suppression of powdery mildew except Prosaro 421 SC 5 fl oz applied solo at FGS 10.5.1. All fungicides applied as split applications and solo after FGS 8 provided significantly greater suppression of tan spot. Palisade numerically reduced both foliar diseases and yield, but these effects were not statistically significant. No phytotoxicity was noted for any treatments.

Treatment[z], Formulation, Rate/A	Application stage (FGS[x])	P. mildew (%)		Tan spot (%)		Yield (bu/A)
Untreated control	--	0.73	a[*]	12.95	a	88.2
Palisade EC 10.5 fl oz	7	0.50	abc	9.17	ab	80.9
Quilt Xcel 2.2 SE 7 fl oz	7	0.59	ab	4.60	bcd	89.3
Palisade EC 10.5 fl oz + Quilt Xcel 2.2 SE 7 fl oz	7	0.64	a-d	9.43	ab	89.6
Palisade EC 10.5 fl oz + Quilt Xcel 2.2 SE 7 fl oz FB Prosaro 421 SC 6.5 fl oz	7 FB 10.5.1	0.23	bcd	0.64	d	83.2
Prosaro 421 SC 6.5 fl oz	10.5.1	0.66	ab	1.28	cd	85.4
Tilt 3.6 EC 2.0 fl oz	5	0.82	a	6.05	bc	86.5
Tilt 3.6 EC 2.0 fl oz FB Quilt Xcel 2.2 SE 10.5 fl oz	5 FB 8	0.02	cd	0.92	d	84.5
Quilt Xcel 2.2 SE 10.5 fl oz	8	0.01	d	1.01	d	82.8
	P(F)	0.01		0.001		0.29

[z] All products with NIS 0.125% (v/v)
[y] FB = followed by
[x] FGS = Feekes growth stage
[*]Column numbers followed by the same letter are not significantly different at *P*=0.05 as determined by Fisher's LSD.

Corn

Corn yields averaged 200 bu/A on 168,000 harvested acres. Overall production was estimated at 33,600,000 bu. Seedling disease caused minimal losses of stand in most fields, although Pythium and Fusarium remain problematic in some areas. Anthracnose was common throughout the state and observed in corn at the vegetative growth stage. However, top dieback and anthracnose stalk rot was not an issue. Grey leaf spot occurred at moderate levels throughout the state. Northern corn leaf blight and Southern rust arrived late in the season and were not likely to impact yields. Fusarium ear rots were detected at low levels. Overall, stalk rots were not a major issue in 2014.

CORN (Zea mays 'DeKalb 6822')
Fusarium stalk rot; *Fusarium graminearum*

N.M. Kleczewski
Department of Plant and Soil Sciences
University of Delaware
Newark, DE 19716

Headline and Capture in furrow application impacts on seedling emergence, dry mass, and yield of corn, 2014.

Headline EC and Capture LFR were evaluated for effects on plant emergence, growth, yield, and stalk strength of corn at the Carvel Research and Education Center located in Georgetown, Delaware. The previous crops were lima beans followed by cover crop wheat. After burndown, the seedbed was prepared by vertical tillage. On 26 Mar, 150 lb/A of 0-0-60 was broadcast and incorporated with a disk. Soil tests from 21-Apr indicated the following: pH- 6.6; OM- 0.8 %; NO_3-N- 3.4 ppm; P- 113.5 ppm; K-191.8 ppm. The experimental design was randomized complete block with 4 replications per treatment. Plots consisted of 4 rows, 54 ft long with 30 in spacing. Plots arranged side by side and were separated by 2 ft allies. The corn hybrid 'DeKalb 6822' was sown at a rate of 2 seed/ft row on 22 Apr. At planting Headline EC or Capture were applied directly in furrow, ontop of the seed at 4 gal/A using a Kinze 4-row planter. Control plots received water in furrow. On 23 Apr, 100 g *Fusarium graminearum* infested wheat kernels were broadcast onto each plot to enhance stalk rot pressure. An additional 25 lb-/ A N (30% UAN) was applied on 24 April. 195 lb-N was sidedressed to all plots on 26 May. Stand counts for each plot were obtained on 7 and 20, May. On 20, May 10 plants were randomly harvested from each plot, washed, separated into above and belowground portions, dried until constant mass and weighed. On 1-Sep, the push test was used to assess stalk strength on 10 plants randomly selected from the inner two rows of each plot. Plots were trimmed to 50 ft to reduce edge effects and and harvested on 15-Sep. Yields are reported at 13% moisture. Analysis of variance was conducted using SPSS v.22. Mean separations were carried out using Fisher's protected least significant difference (LSD) test (P<0.05).

There were no differences in seedling populations 7 May; however, populations were greater for Headline EC and Capture LFR treatments on 20 May. No differences in root mass, seedling drymass, or yield were detected. No lodging was detected for any plots using the push test. Yields did not differ significantly among treatments. Additional trials are planned to assess treatment effects in different soil types or growing conditions.

	Plants / A		Root drymass	Seedling drymass	Yield
Treatment	7-May	20-May	(%)	(g)	(bu/A)
Untreated Control	33,454a[z]	32,234a	78.4a	6.2a	202a
Headline EC 3 oz/A	31,711a	33,976b	73.1a	5.1a	190a
Capture LFR 8.5 oz/A	32,757a	33,976b	74.7a	5.7a	197a

[z]Means followed by the same letter in each dependent variable are not significantly different according to Fisher's protected least significant difference (LSD) test (P<0.05).

Soybean

Soybean yields averaged 48 bu/A in 2014 on 183,000 harvested acres. Overall production was estimated at 8,784,000 bu. Seedling diseases occurred in full season diseases at low/moderate levels. Predominant issues included Fusarium spp. and Pythium spp. Soybean cyst nematode, as usual, was the largest issue in soybean production. Root knot nematode was also observed at damaging levels in some soybean fields. Soybean sudden death syndrome occurred sporadically at low/moderate levels in full season beans. Viral diseases such as Tobacco ringspot were detected at low levels. Soybean vein necrosis virus was abundant but low in severity. Foliar diseases such as downy mildew appeared early, but increasing temperatures resulted in little to no yield impacts. Frogeye leafspot was detected at damaging levels in some fields. The most common disease was Septoria leaf spot; however, the disease was not detected in upper portions of the canopy and therefore likely resulted in minimal yield losses. Purple seed stain and stem canker were also observed at low levels in some fields.

Soybean (*Glycine max*)

Septoria brown spot, (*Septoria glycines*)
Frogeye leaf spot (*Cercospora sojina*)
Soybean Vein Necrosis Virus (SVNV)

N.M. Kleczewski Ph.D.
Extension Field Crops Plant Pathologist
University of Delaware

Soybean Disease Evaluations-2014

Disease severity was evaluated at the soybean variety trial located in Middletown, Delaware. The variety trial tests the adaptability of soybean varieties to Delaware growing conditions and susceptibility to common diseases in the region. Few diseases were present during the 2014 growing season. Pathogens detected in the Middletown variety trial included Septoria brown spot (BS), Soybean Vein Necrosis Virus (SVNV), and Frogeye leaf spot (FLS). BS and SVNV were dispersed uniformly and at levels high enough to rate. FLS was rated as presence or absence on a variety, as levels in the canopy were low during the rating period.

The disease ratings were made on September 3rd, 2013. The stage of development was R6. Plots were identified with numbers and not variety identifications. There were 3-4 plots per variety. Disease ratings were made on whole plots by rating the mid-canopy for BS and upper canopy for SVNV using a 5-point scale where **0 = no disease, 1 = less than 10% disease; 2 = 10-25% disease; 3 = 25-50% disease; and 4 = more than 50% disease.** Two raters independently rated each plot and scores were averaged to minimize rater bias. Frogeye leaf spot was rated as present or absent (yes/no). Means are presented in Tables 1 and 2.

In the trial group 3 beans had an average rating of 1.5 for BS and 0.82 for SVNV. The average ratings for group 4 beans was 1.0 for BS and 0.3 for SVNV. Overall levels of diseases were low. Across Delaware, BS, SVNV, and soybean cyst nematode were most prevalent diseases encountered. FLS was detected in some fields at high levels (>25% severity at R6), but overall levels across the state were negligible. Other diseases detected were Downy mildew, Sclerotinia stem blight, Cercospora leaf blight/purple seed stain, Anthracnose, Phomopsis, and Sudden Death Syndrome (full-season beans).

Variety	BS*	SVNV**	FLS***
SS 3813N	1.19	0.37	N
USG 39RY43	1.19	0.46	Y
HS39T44	1.25	0.89	N
USG 37RY47	1.31	0.63	Y
USG 73P93R	1.33	0.98	N
HS39A22	1.38	0.79	Y
S39RY65	1.40	0.64	N
DB3815RR	1.41	0.88	Y
SS 3811N	1.44	0.47	Y
SS 3914NS	1.50	0.75	Y
S39-T3	1.56	1.20	Y
TS3959R2S	1.56	0.90	Y
USG 536RY24	2.25	0.90	N
DB3315RR	2.25	1.70	N

Table 1. Ratings of 14 group 3 beans in the University of Delaware wheat variety trials in 2014. The site located in Middletown, Delaware was used in this test. Disease ratings were made at R6 on whole plots by rating the mid-canopy for BS and upper canopy for SVNV using a 5-point scale where **0 = no disease, 1 = less than 10% disease; 2 = 10-25% disease 3 = 25-50% disease and 4 = more than 50% disease.** Two raters independently rated each plot and scores were averaged to minimize rater bias. FLS was rated as present or absent (yes/no). * Septoria Brown Spot; ** Soybean Vein Necrosis Virus; *** Frogeye leaf spot

Variety	BS*	SVNV**	FLS***
Mycogen 5N479R2	.50	0.16	N
S48RS53	.53	0.07	N
HS47T12	.63	0.06	N
HS49T14	.67	0.28	Y
HBK5221R4	.78	0.27	Y
HBK4721RY	.80	0.01	N
S46RY85	.80	0.28	Y
SS4725N7	.80	0.12	N
HS42T14	.83	0.32	N
SS4913NR2	.84	0.06	Y
SS4700R2	.88	0.29	N
HS42A44	.93	0.27	Y
SS4514N	.95	0.19	Y
BX4959RY	1.00	0.53	N
HS45A14	1.00	0.07	N
Mycogen 5N423R2	1.00	0.40	Y
SS4714NS	1.00	0.16	Y
SS4917N	1.00	0.32	Y
USG74B42R	1.00	0.16	Y
HBK4620RY	1.08	0.40	Y
SS4312N	1.08	0.32	N
S41-J6	1.08	0.43	Y
USG74D32R	1.08	0.19	N
USG74B94RS	1.11	0.33	Y
DB4715RR	1.17	0.43	N
Mycogen 5N413R2	1.19	0.51	N
USG74F24RS	1.19	0.16	N
DB4415RR	1.25	0.37	N
S43RY95	1.25	0.15	N
USG74F12R	1.34	0.63	Y
SS4114N	1.38	0.50	N
HS44T14	1.42	0.26	N
USG74A69R	1.42	0.34	Y
S46-L2	1.50	0.33	Y
S43-K1	1.50	0.17	Y
S40RY25	1.56	0.24	N

Table 2. Ratings of 35 group 4 beans in the University of Delaware wheat variety trials in 2014. The site located in Middletown, Delaware was used in this test. Disease ratings were made at R6 on whole plots by rating the mid-canopy for BS and upper canopy for SVNV using a 5-point scale where **0 = no disease, 1 = less than 10% disease; 2 = 10-25% disease 3 = 25-50% disease and 4 = more than 50% disease.** Two raters independently rated each plot and scores were averaged to minimize rater bias. FLS was rated as present or absent (yes/no). * Septoria Brown Spot; ** Soybean Vein Necrosis Virus; *** Frogeye leaf spot

SOYBEAN (*Glycine max* 'Dynagro-39RY43')
Brown spot; *Septoria glycines*

N.M. Kleczewski
University of Delaware
Department of Plant and Soil Sciences
Newark, DE 19716

Effect of foliar fungicides and application timings on full season soybean in Newcastle County Delaware, 2014.

The trial was conducted at the Middletown Research and Demonstration farm located in Middletown, Delaware. The soybean variety Dynagro39RY43 was planted at 1.5 x 10^5 seeds/A on 6 May in rows 7.5-in apart. The previous crop was corn followed by wheat, lightly disked before planting. Experimental plots ? were 10 x 25 ft. There was 5 ft of untreated soybeans at plot ends. Nutrients were applied following standard management guidelines for Delaware. The experimental design was a randomized complete block with 5 replications. Fungicide applications were applied with a CO_2 pressurized backpack sprayer with four Teejet 8002 flat fan nozzles spaced 18-in. apart on an offset handheld boom. Applications were made at 35 psi at a pace to deliver 20 gal/A of spray solution to the inner 8 rows per plot. Treatments were applied at 7 July, 4 Aug, and 20 Aug at growth stage V5, R3, and R5 respectively. Disease evaluations were conducted at R6 on 3 Sep and 4 Sep on the 3rd node down from the lowest node. Brown spot (BS) evaluations were performed on 5 arbitrarily selected plants per plot by visually estimating the percent of diseased leaf area on the central leaflet. The inner 5 ft of each plot was harvested on 28 Oct using a small plot combine. Data were analyzed by ANOVA, and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons. Yields were calculated based on a 60 lb bushel weight and adjusted to 13% moisture.

Disease pressure was low in this trial. Symptoms of BS were first observed on 22 August and disease remained low in the canopy throughout the remainder of the season. All treatments applied at V5 reduced BS relative to the control. Stratego YLD applied at 4 oz/A at R3 was the only treatment applied after V5 that significantly reduced BS compared to the control. No effects of treatment on yield, test weight, or phytotoxicity were noted.

Treatment[z], and rate/A	Application stage	Brown spot (%)		Test weight (lb/bu)	Yield (bu/A)
Untreated control	--	12.5	a[x]	59.4	55.8
Stratego YLD 500SC, 2 fl oz	V5	4.3	c	58.6	51.6
Stratego YLD 500SC, 4 fl oz	V5	3.1	c	59.1	59.5
Stratego YLD 500SC, 4 fl oz	R3	4.2	c	59.1	57.3
Stratego YLD 500SC, 4 fl oz	R5	9.5	ab	59.1	53.1
Affiance 1.50SC, 10 fl oz	R3	8.1	ab	58.9	57.0
Affiance 1.50SC, 10 fl oz	R5	11.1	a	59.3	57.4
Domark 230ME, 4 fl oz	R3	7.0	ab	59.0	59.4
Domark 230ME, 4 fl oz	R5	9.2	ab	59.1	58.8
Quadris Top 2.72SC, 8 fl oz	V5	4.0	c	59.0	56.2
Quadris Top 2.72SC, 8 fl oz	R3	5.6	abc	59.0	57.4
Quadris Top 2.72SC, 8 fl oz	R5	9.4	ab	59.2	60.7
Quadris Top 2.72SC, 8 fl oz FB Quadris Top 2.72SC, 8 fl oz	R3 FB[y] R5	8.1	ab	58.7	60.7
Priaxor 500SC, 4 fl oz	R3	6.4	bc	58.7	61.3
Priaxor 500SC, 4 fl oz	R5	8.9	ab	59.1	56.9
Aproach 2.08SC, 6 fl oz	R3	9.7	ab	58.9	55.3
Aproach 2.08SC ,6 fl oz	R5	8.7	ab	58.8	60.4
Aproach Prima 1.34SC, 6.8 fl oz	R3	8.3	ab	59.1	58.8
Aproach Prima 1.34SC, 6.8 fl oz	R5	12.4	ab	59.4	60.4
Aproach Prima 1.34SC, 6.8 fl oz FB Aproach Prima 1.34SC, 6.8 fl oz	R3 FB R5	7.6	ab	58.9	59.1
	P(F)	<0.001		0.56	0.68

[z] All products were applied with a non-ionic surfactant (NIS) 0.125% (v/v) except Stratego YLD which included NIS at 0.250% (v/v)
[y] FB = followed by
[x]Column numbers followed by the same letter are not significantly different at *P*=0.05 as determined by Fisher's LSD.

SOYBEAN (*Glycine max* 'Hubner H42-12R2-UP')
Brown spot; *Septoria glycines*;
Purple seed stain; *Cercospora kikuchi*i

N.M. Kleczewski
University of Delaware
Department of Plant and Soil Sciences
Newark, DE 19716

Effect of foliar fungicides and application timings on full season soybean in Delaware, 2014.

The trial was conducted at the Carvel Research and Education Center near Georgetown, Delaware. The soybean variety 'Hubner H42-12R2-UP' was planted at 1.5 x 10^5 seeds/A on 14 May in rows 30-in. apart. The previous crop was lima beans and cover crop wheat, vertically tilled before planting. Experimental plots were 10 x 30 ft. There was 5 ft of untreated soybeans at plot ends. Lime was applied at 1 ton /A and Nitrogen (UAN) was applied at 150 lb/A on 10 and 11 Apr, respectively. Standard weed and insect management procedures were followed. The experimental design was a randomized complete block with 5 replications. Fungicide applications were applied with a CO_2 pressurized backpack sprayer with four Teejet 8002 flat fan nozzles spaced 18-in. apart on an offset handheld boom. Applications were made at 35 psi at a pace to deliver 20 gal/A of spray solution to the inner 2 rows per plot. Treatments were applied at 27 June, 1 Aug 1, and 17 Aug at growth stage V5; R3; and R5. Disease evaluations were conducted at R6 on 5 Sep on the 10^{th} node down from the uppermost node (brown spot) and at maturity (purple seed stain). Brown spot (BS) evaluations were made on 5 randomly selected plants per plot by visually estimating the percent of diseased leaf area. Purple seed stain was assessed by rating seed from 20 arbitrarily collected pods per plot on 16 Oct. The inner 2 rows of plots were harvested on 19 Oct. Brown spot severity was log transformed to meet assumptions of ANOVA. Data were analyzed by ANOVA, and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons. Yields were calculated based on a 60 lb bushel weight and adjusted to 13% moisture.

Disease pressure was low in this trial. Symptoms of BS were first observed on 3 August. All treatments reduced BS relative to controls. Quadris Top and Aproach Prima applied at R3 followed by R5 provided the best control of BS. Aproach Prima was the only product applied at V5 that significantly reduced purple seed stain. Quadris Top applied at R3 and R5 provided the greatest control of purple seed stain. No effects of treatment on yield or phytotoxicity were noted.

Treatment[z] and rate/A	Application stage	Brown spot (%)		Purple seed stain (%)		Yield (bu/A)
Untreated control	--	19.9	a[x]	9.5	a	59.6
Stratego YLD 500SC, 2 fl oz	V5	3.0	b-d	6.0	a-d	58.0
Stratego YLD 500SC, 4 fl oz	V5	3.5	b-e	5.0	a-d	59.5
Stratego YLD 500SC, 4 fl oz	R3	1.4	d-g	4.0	cd	62.9
Affiance 1.50SC, 10 fl oz	R3	1.8	c-g	3.5	cd	60.6
Domark 230ME, 4 fl oz	R3	2.3	c-g	5.9	a-d	56.9
Tilt 3.6EC, 6 fl oz	R3	4.4	bc	7.0	abc	58.5
Quadris Top 2.72SC, 8 fl oz	V5	3.2	bcd	4.8	a-d	58.5
Quadris Top 2.72SC, 8 fl oz	R3	1.0	efg	6.1	a-d	60.5
Quadris Top 2.72SC, 8 fl oz FB Quadris Top 2.72SC, 8 fl oz	R3 FB[y] R5	0.5	g	0.3	e	56.9
Priaxor 500SC, 4 fl oz	V5	4.6	b	9.2	ab	58.1
Priaxor 500SC, 4 fl oz	R3	1.0	fg	5.0	bcd	60.4
Aproach 2.08SC, 6 fl oz	R3	1.6	b-f	4.6	a-d	56.8
Aproach Prima 1.34SC, 6.8 fl oz	V5	2.2	d-g	3.7	cd	59.4
Aproach Prima 1.34SC,6.8 fl oz	R3	1.4	d-f	10.4	a	61.2
Aproach Prima 1.34SC 6.8 fl oz FB Aproach Prima 1.34SC 6.8 fl oz	R3 FB R5	0.5	g	2.8	de	60.9
	P(F)	<0.001		<0.001		0.4

[z] All products were applied with a non-ionic surfactant (NIS) 0.125% (v/v) except Stratego YLD which included NIS at 0.250% (v/v)
[y] FB = followed by
[x]Column numbers followed by the same letter are not significantly different at *P*=0.05 as determined by Fisher's LSD.

<u>Delaware Soybean Board Funded Project</u>

Evaluating the Distribution and Potential Impacts of Soybean Vein Necrosis Virus in Delaware

Brief Overview of 2014 Results

Background and Objectives:

Soybeans are susceptible to viruses, non-living packets of genetic code encapsulated within a protein coat. Viruses are unique pathogens in that they grow and reproduce only inside living plant cells, using the plants own molecular machinery to reproduce. Infected soybeans tend to be stunted and produce fewer pods. Foliage may be distorted and have a mottled or mosaic appearance. Seed may also be mottled and deformed. Many symptoms of viral infection in soybeans resemble damage due to common fungal and nematode pathogens, insects, nutrient deficiencies, and even herbicide injury and often go unnoticed in fields. If left unmanaged, severe yield losses can occur with some viruses.

In 2011 a new soybean virus was detected in soybean fields in Maryland and Delaware. This virus has recently been named Soybean Vein Necrosis Virus (SVNV), and it has been found throughout Eastern and Midwest soybean growing regions. Currently SVNV is considered the most widespread virus of soybeans in the United States. Although we know little about this virus, we do know that it is vectored by thrips and has several alternate hosts, such as Ivy leaf Morning Glory. In 2013 several samples brought into the Delaware Plant and Pest Diagnostic Clinic tested positive for the disease, and I personally observed the disease in 5-10% of fields. According to agents, this may be less than what was observed in years past. However, no focused surveys of this virus have been conducted in the Midatlantic and the distribution of this virus and its potential impacts on Delaware soybean yields are unknown. A better understanding of the distribution and effects of the virus in Delaware are required to determine if soybean yields are being affected, what practices favor the disease, and if needed, potential management options. Research on SVNV is necessary to ensure maximum yields of full season and double cropped soybeans in Delaware.

The project has multiple general goals

1) Estimate the incidence and severity of Soybean Vein Necrosis Virus (SVNV) in Delaware soybeans.
2) Estimate reductions in yield or quality due to SVNV.
3) Obtain information on practices and conditions that may be associated with SVNV incidence, severity, and yield loss.

<u>Report on Progress/Activity</u>

Objective 1

Symptom Development

A total of 29 growers across Delaware allowed fields to be surveyed for SVNV (Table 1). I scouted 64 fields (28 double crop) from June-September, making 128 total field visits. Forty-nine of the fields were surveyed at least twice, once early in the growing season, between VE and R1, and a second time between R3 and R6. Thirty-three samples of soybean foliage covering a range of different symptoms were sent for confirmation of SVNV. All samples that were assumed to be infected with the virus tested positive (31/31) and two samples assumed to not be infected tested negative. This indicated that in-field diagnostics were accurate. Therefore, visual diagnosis was used to confirm SVNV during the remainder of growing season. Symptoms from virus-infected plants varied from clearing of leaf tissue to bleeding of leaf veins, to presence of necrotic lesions and defoliation (Figure 1. A-H).

Figure 1. Examples of symptoms of Soybean Vein Necrosis Virus in Delaware soybeans. A) Initial symptoms appear as small areas, light green in color, associated with veins. At this stage symptoms may resemble downy mildew; B) As symptoms progress, veins may "clear"; C-E) Over time, the light green lesions start to turn yellow; F) Lesions of multiple ages can be found on the same leaf [old lesion (blue circle) and a younger lesion (red circle)]; G) Over time lesions become brown and if symptoms are severe, defoliation may occur; H) From a distance SVNV may resemble brown spot or other foliar diseases.

Table 1. Breakdown of survey sites based on county and cropping system

County	# Growers	# Fields	# Full season
Newcastle	7	12	10
Kent	16	27	12
Sussex	14	26	6

SVNV Incidence by County and Cropping System

Of the 64 fields included in this survey, 60 (94%) were infected with SVNV (Table 2). Overall, field severity averaged 11%, and ranged from 0-100%. Although field-level incidence was high, the majority of fields (88%) had severity levels less than 5% (Table 2). Field incidence differed by county (Table 2). When averaged across counties, severity was greater in Kent (16.5%) compared to Newcastle (14%) and Sussex counties (3%). Symptoms of SVNV appeared as early as July 15 and increased over the course of the growing season (Figure 2). The field level incidence detected in 2014 was greater than what was previously reported by consultants and agents in Delaware. Observed levels of severity suggest that the 2014 season was not severe for SVNV in the majority of Delaware fields, but significant variability in severity was evident. However, survey results indicate that SVNV can appear early in the growing season. In general, the potential for yield reduction from viruses increases when infection occurs early in plant growth and development.

Table 2. Overall incidence and severity of Soybean Vein Necrosis Virus in Delaware for the 2014 soybean growing season.

County	**Field Incidence**	**Average Severity**	**No. <5% Severity**
Newcastle	9/11 (82%)	14%	8 (89%)
Kent	26/27 (96%)	16.5%	23 (85%)
Sussex	25/26 (96%)	3%	22 (88%)
Total	**60/64 (94%)**	**11%**	**53 (88%)**

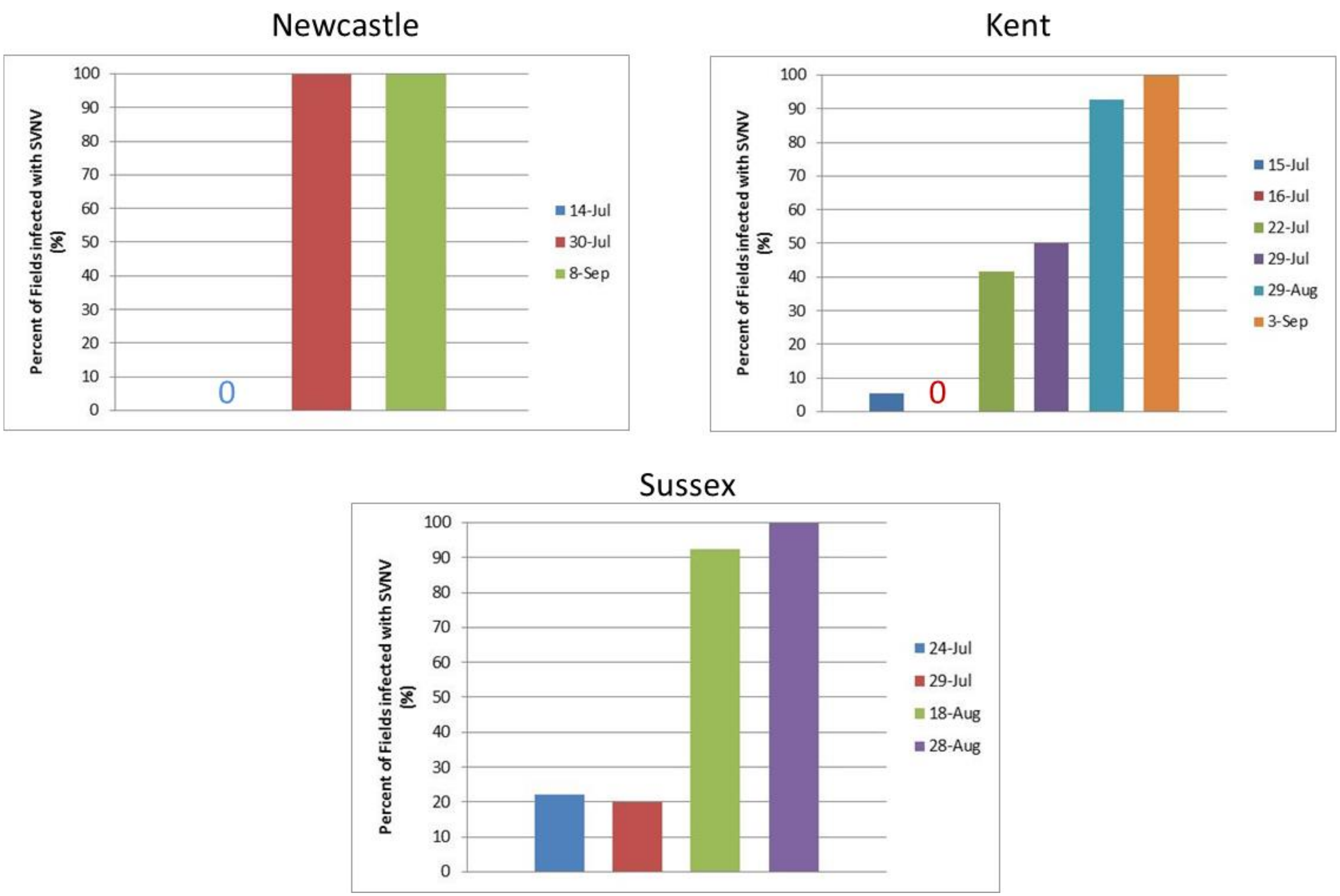

Figure 2. The percent of fields with Soybean Vein Necrosis Virus (SVNV) increased over time across all three counties.

Objective 2.
Initially it was assumed that SVNV would be difficult to encounter in Delaware due to input from local agricultural professionals. However, as shown under **Objective 1**, this was not true in 2014. Consequently, soybeans were collected from only two sites.

Full-season soybeans (Dynagro- 39RY43; Pioneer 93Y84) were harvested at R6 from research/demonstration trials at the Middletown Research and Demonstration Field (Dynagro) and a Newcastle County grower field (Pioneer). A total of 175 plants with varying degrees of SVNV symptoms were harvested, stored in a walk in cooler at 4°C and processed within 10 days. Several different soybean data were collected that might be impacted by the presence of a virus (Table 3).

Table 3. Soybean measurements made on 175 full-season soybeans (Dynagro- 39RY43; Pioneer 93Y84) harvested at R6 from the Middletown Research and Demonstration Field located in Middletown Delaware and a Newcastle grower field. Plants were selected that had a range of SVNV symptoms.

Measurement	Purpose
Plant height	Some viruses can reduce internode length
Number of nodes with virus vs total nodes on plant	Indicates severity of SVNV on entire plant. Individual leaf severity not rated.
Pod number	Related to yield
Beans per pod	Related to yield
Average bean weight	Related to yield and quality

Relationship between measured variables

Correlations were conducted to assess the overall relationship between SVNV and other measured variables. Correlations quantify the degree that two variables are related. To do this a correlation coefficient (r) is computed that tells us how much one variable changes when the other one does. When r is 0, no relationship exists. When r is positive, there is a trend that one variable increases as the other one increases. When r is negative, there is a trend that one variable increases as the other one decreases. Analysis of the 175 soybean plants indicated that there was a significant, slightly negative correlation between the percent of SVNV infected nodes and plant height, and a significant positive correlation between average bean weight and SVNV severity. Average bean size was significantly negatively correlated with pods per plant and plant height (Table 4).

Table 4. Non-parametric correlations between variables indicated a slightly negative correlation between the SVNV severity and plant height and a significant positive correlation between SVNV severity and average bean weight. Reduced plant size was correlated to fewer pods and beans per pod. * = significant at P = 0.05; ** = significant at P = 0.01. **Green text indicates a correlation associated with SVNV severity.**

		SVNV Severity	Plant height	Beans per pod	Avg bean weight
Pods per plant	r	.043	.261**	.129	-.164*
	Sig. (2-tailed)	.575	.000	.089	.031
	N	175	175	174	174
SVNV Severity	r		**-.160***	-.123	**.343****
	Sig. (2-tailed)		**.034**	.106	**.000**
	N		**175**	174	**174**
Plant height	r			.179*	-.376**
	Sig. (2-tailed)			.018	.000
	N			174	174
Beans per pod	r				.144
	Sig. (2-tailed)				.058
	N				174

In an effort to determine how SVNV severity ratings related to plant measurements, linear models were fitted between SVNV and measured variables. The ability of SVNV severity to predict changes in measured, independent variables was tested using ANOVA (Table 5). Weak, statistically significant linear relationships were found between SVNV and plant height (Figure 4) and average bean weight (Figure 5), which supported results generated from non-parametric correlations. SVNV explained approximately 28% of the variation in plant height and 43% of the variation in average bean mass, respectively. The results here suggest that there is a relationship between SVNV and plant height, and bean weight, but other factors not measured accounted for a great deal of plant to plant variability. The association between pod number per plant and SVNV severity approached significance at P = 0.10. SVNV severity only explained approximately 14% of variability in pod number per plant (Figure 6). Part of this can be explained by innate variation between fields and varieties. However, it is also important to note that the amount of severely infected plants (more than 50% severity) was fairly low and only 11 plants had severity levels greater than this level. It is likely that the effects of SVNV are more pronounced when plants express severe symptoms.

Table 5. Linear regression analysis for SVNV severity and measured plant variables. Regression analysis indicated that SVNV severity had a linear relationship with plant height and average bean weight.

Independent variable	ANOVA Significance
Plant height	**0.0001**
Pods per plant	0.120
Beans per pod	0.433
Average bean weight	**0.0001**

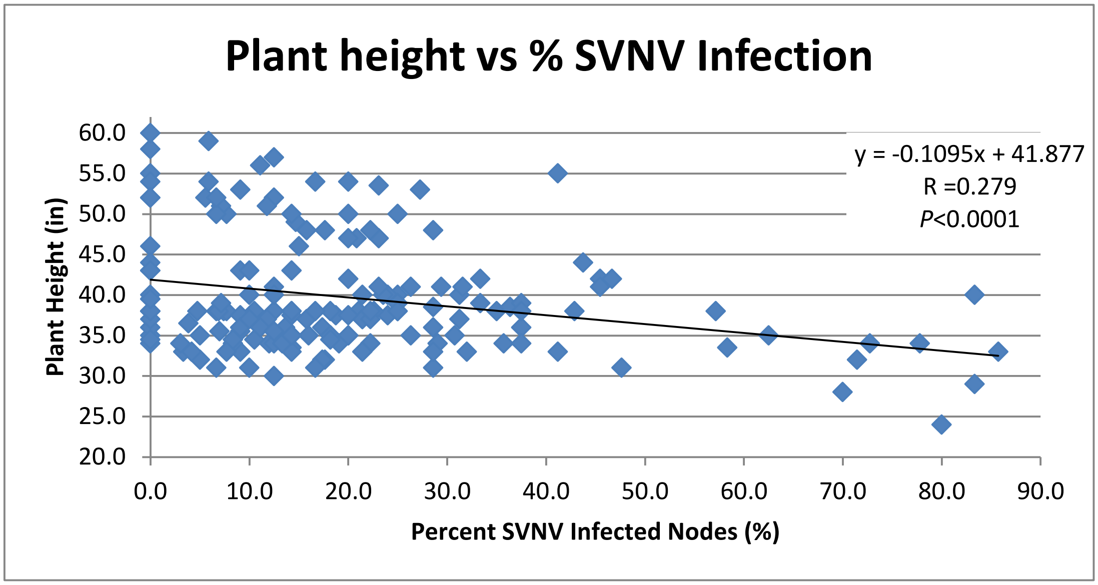

Figure 4. The linear relationship between SVNV severity and plant height. SVNV infection explained approximately 28% of the variation in plant height.

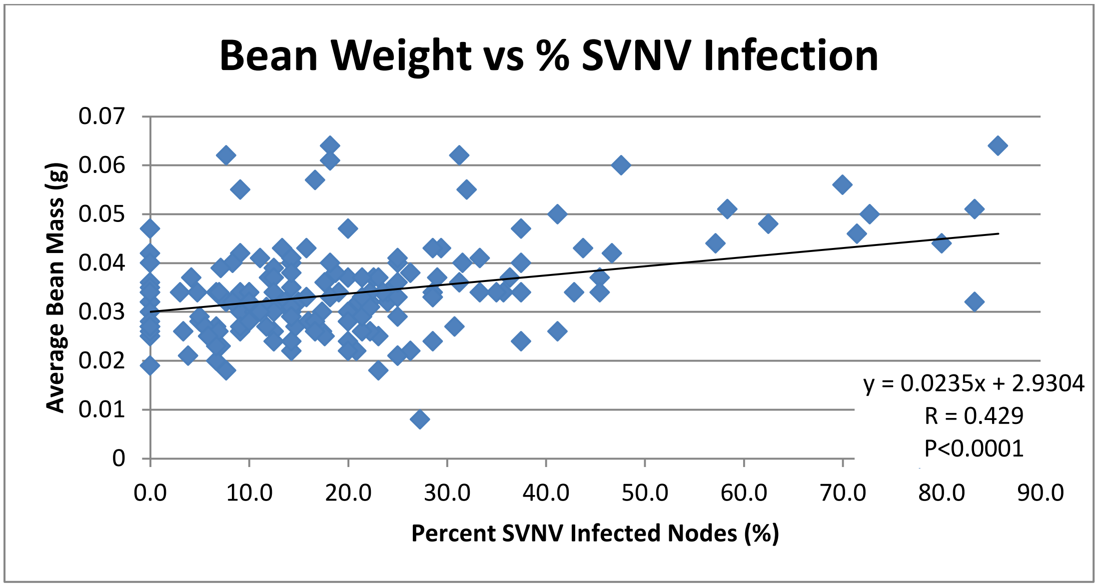

Figure 5. The linear relationship between SVNV severity and average bean weight. SVNV infection explained approximately 43% of the variation in average bean weight.

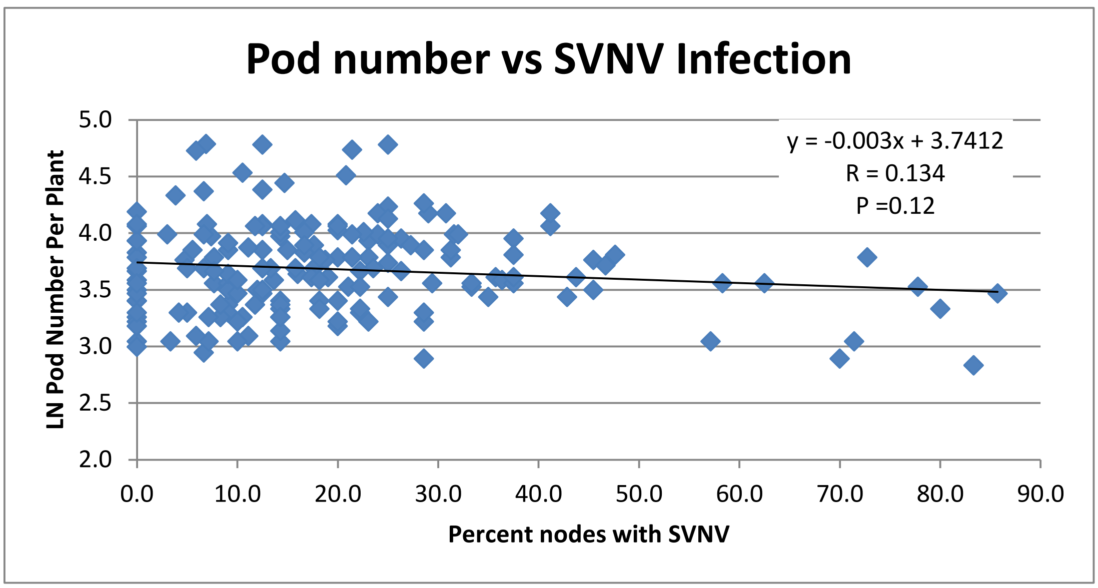

Figure 6. The linear relationship between SVNV severity and pod number per plant. A natural log (LN) transformation was used to linearize the data. Only 13% of variability in pod number per plant was explained by SVNV severity. In this model a SVNV free soybean plant would be predicted to produce roughly 45 pods per plant, whereas a plant with 85% SVNV severity is predicted to produce approximately 31 pods per plant.

Objective 3.

Observations were taken in fields throughout the growing season on patterns and other items of note that may be related to SVNV symptom development, incidence, or severity. First, symptoms were most evident, and often most severe, along field edges. Field edges near forest lines appeared to have more severe symptoms than those near ditches. Second, in most cases increased symptom severity was observed in plants in close proximity to weeds such as Ivyleaf Morning Glory. The field with the most severe symptoms was located near a creek where a large amount of Ivy Leaf Morning Glory could be found. There was no apparent association between SVNV symptoms and other foliar diseases, such as Septoria brown spot, Frogeye leaf spot, and Downy mildew. Irrigation did not appear to be a factor in symptom development.

Summary

This survey showed that SVNV can be prevalent in Delaware soybeans, and that symptoms can be found early in plant development for both full and double crop soybeans. The correlations between SVNV severity and aspects of soybean growth were consistent with results from the Mid-West. However, because Thrips may overwinter in the Mid-Atlantic there is a greater likelihood for SVNV-related damage due to earlier arrival of the vector and virus. Symptoms of SVNV are variable and can be easily misdiagnosed as other disorders. However, based on this survey it is possible to accurately diagnose SVNV based on visible symptoms once the eye is attuned to the subtleties of the virus. More work needs to be conducted to determine the relationship between Thrips arrival and disease symptoms, the potential impacts of SVNV on crop yields, and weeds as viral reservoirs. An understanding of these factors will assist in constructing management guidelines if they are required.