



**Final Report 2019**  
**Pennsylvania Soybean Board**

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## Seed Treatment Trials

### Individual Trial Reports for Seed Treatment Trials

#### Field Information

**Field Code:** ST19\_C

**Location/Farm:** Wellsboro

**Variety:** F2F2G-228A

**County:** Tioga

**Trial Type:** Seed Treatment

**Planting Date:** 6/5/2019

**Replications:** 4

#### Treatments

Apron Maxx RTA vs. Untreated Control

#### Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at V4 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield was recorded at harvest.

#### Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	13.48	14.40	Not Significant
Taproot length (cm)	13.90	14.90	Not Significant
Root weight (g/plant)	8.41	9.90	Not Significant
Shoot weight (g/plant)	14.27	18.58	Not Significant
Initial plant stand (per acre)	65340	66792	Not Significant
Final plant stand (per acre)	NA	NA	NA
Greenseeker V1	0.70	0.70	Not Significant
Greenseeker R1	0.60	0.50	Not Significant
Greenseeker R6	0.70	0.70	Not Significant
Yield (bu/ac)	36.00	36.00	Not Significant

#### Soil nutrient profile

Parameter	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA

Soil pH	6.3	6.4	6.8
Phosphorus (P) (ppm)	33.0	36.0	37.0
Potassium (K) (ppm)	150.0	52.0	116.0
Magnesium (Mg) (ppm)	92.0	61.0	101.0
Calcium (ppm)	1496.5	1056.3	1330.5
Acidity (meq/100 g)	4.20	2.80	2.00
CEC (meq/100 g)	12.9	8.7	9.8
Organic Matter %	5.3	5.7	4.5
Zinc (ppm)	1.6	1.4	1.5
Copper (ppm)	1.1	1.1	1.2
Sulfur (ppm)	15.2	14.2	11.2
% Saturation of the CEC for:			
K	3.0	1.5	3.0
Mg	6.0	5.8	8.6
Ca	58.4	60.5	67.9

### Soil nematode profile

Nematode	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	25	10	0
Stunt	0	0	80
Spiral	0	40	0
Stubby root	0	0	0
Dagger	0	0	0
Ring	0	0	0
Lance	0	0	0
Pin	0	0	0
Action Code	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

**Comments:** Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.

### Field Information

**Field Code:** ST19\_A

**Location/Farm:** Pennsylvania Furnace

**Variety:** F2F2G-258A, 22RL12412

**Replications:** 3

**County:** Centre

**Trial Type:** Seed Treatment

**Planting Date:** 5/3/2019

### Treatments

Apron Maxx RTA vs. Untreated Control

### Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at V4 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield was recorded at harvest.

### Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	16.03	16.77	Not Significant
Taproot length (cm)	13.93	14.23	Not Significant
Root weight (g/plant)	6.77	7.18	Not Significant
Shoot weight (g/plant)	18.37	18.22	Not Significant
Initial plant stand (per 1 meter)	NA	NA	NA
Final plant stand (per 1 meter)	NA	NA	NA
Greenseeker V1	NA	NA	NA
Greenseeker R1	NA	NA	NA
Greenseeker R6	NA	NA	NA
Yield (bu/ac)	NA	NA	NA

### Soil nutrient profile

Parameter	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.7	7.2	7.1
Phosphorus (P) (ppm)	128.5	156.0	118.0

Potassium (K) (ppm)	141.5	222.0	196.0
Magnesium (Mg) (ppm)	161.0	248.0	239.0
Calcium (ppm)	1216.0	1630.4	1615.7
Acidity (meq/100 g)	2.50	0.00	0.00
CEC (meq/100 g)	10.3	10.8	10.6
Organic Matter %	2.6	3.3	2.9
Zinc (ppm)	4.0	3.6	3.6
Copper (ppm)	34.4	28.2	24.3
Sulfur (ppm)	8.9	9.2	8.5
% Saturation of the CEC for:			
K	3.5	5.3	4.8
Mg	13.0	19.2	18.8
Ca	59.1	75.6	76.4

### Soil nematode profile

Nematode	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	15	12	11
Stunt	80	0	0
Spiral	180	800	444
Stubby root	0	0	0
Dagger	0	0	0
Ring	0	0	0
Lance	0	62	155
Pin	0	0	0
Action Code	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.

## Field Information

**Field Code:** ST19\_N  
**Location/Farm:** Turtlepoint  
**Variety:** F2F2G-228A  
**Replications:** 3

**County:** McKean  
**Trial Type:** Seed Treatment  
**Planting Date:** 6/15/2019

## Treatments

Apron Maxx RTA vs. Untreated Control

## Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at V4 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.  
Yield was recorded at harvest.

## Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	15.40	15.30	Not Significant
Taproot length (cm)	11.97	12.17	Not Significant
Root weight (g/plant)	7.50	7.85	Not Significant
Shoot weight (g/plant)	20.42	20.25	Not Significant
Initial plant stand (per 1 meter)	23.30	26.30	Not Significant
Final plant stand (per 1 meter)	24.60	23.90	Not Significant
Greenseeker V1	0.60	0.60	Not Significant
Greenseeker R1	0.77	0.69	Not Significant
Greenseeker R6	0.76	0.71	Not Significant
Yield (bu/ac)	16.50	16.50	Not Significant

## Soil nutrient profile

Parameter	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.4	6.8	7.0
Phosphorus (P) (ppm)	21.0	23.0	26.0
Potassium (K) (ppm)	46.0	47.0	53.0
Magnesium (Mg) (ppm)	81.0	93.0	103.0
Calcium (ppm)	1876.5	1971.1	2672.2
Acidity (meq/100 g)	3.35	2.80	0.00
CEC (meq/100 g)	13.5	13.6	14.4
Organic Matter %	2.5	2.5	2.4

Zinc (ppm)	1.3	1.8	2.6
Copper (ppm)	2.6	1.7	1.8
Sulfur (ppm)	6.1	6.6	7.1
% Saturation of the CEC for:			
K	0.9	0.9	0.9
Mg	5.0	5.7	6.0
Ca	69.9	72.7	93.1

### Soil nematode profile

Nematode	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	85	90	50
Stunt	40	0	0
Spiral	80	40	40
Stubby root	0	0	0
Dagger	0	0	0
Ring	0	0	0
Lance	20	10	10
Pin	0	0	0
Action Code	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP

### Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.

## Field Information

**Field Code:** ST19\_D  
**Location/Farm:** SEAREC  
**Variety:** FBN 2.9  
**Replications:** 6

**County:** Lancaster  
**Trial Type:** Seed Treatment  
**Planting Date:** 5/2/2019

## Treatments

Apron Maxx RTA vs. Untreated Control

## Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at V4 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield was recorded at harvest.

## Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	13.77	14.20	Not Significant
Taproot length (cm)	9.38	9.00	Not Significant
Root weight (g/plant)	5.88	5.96	Not Significant
Shoot weight (g/plant)	16.72	17.28	Not Significant
Initial plant stand (per 1 meter)	9.89	9.70	Not Significant
Final plant stand (per 1 meter)	NA	NA	NA
Greenseeker V1	0.50	0.50	Not Significant
Greenseeker R1	0.80	0.80	Not Significant
Greenseeker R6	0.90	0.90	Not Significant
Yield (bu/ac)	93.4	90.8	Not Significant

## Soil nutrient profile

Parameter	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.5	6.5	6.2
Phosphorus (P) (ppm)	100.0	128.0	100.0
Potassium (K) (ppm)	235.0	301.0	296.0
Magnesium (Mg) (ppm)	181.0	210.0	222.0
Calcium (ppm)	917.5	937.8	952.1
Acidity (meq/100 g)	2.80	2.80	2.20
CEC (meq/100 g)	9.5	10.0	9.6

Organic Matter %	2.5	2.9	3.0
Zinc (ppm)	3.7	3.6	3.5
Copper (ppm)	4.7	4.6	4.3
Sulfur (ppm)	6.7	9.3	10.4
% Saturation of the CEC for:			
K	6.4	7.7	7.9
Mg	15.9	17.5	19.3
Ca	48.3	46.8	49.7

**Soil nematode profile**

Nematode	Pre-planting	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	10	442	12
Stunt	20	0	0
Spiral	140	1428	200
Stubby root	0	0	0
Dagger	0	0	0
Ring	0	0	0
Lance	15	0	0
Pin	0	0	0
Action Code	A	A	D

**Nematode damage thresholds for soybean**

CROP HOST: Soybean	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

**Damage Threshold**

	Low
	Moderate
	High

**Action Code(s) (if present)**

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

**Comments:**

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.

## Yield-Limiting Trials

### Individual Trial Reports for Yield-Limiting Trials

#### Field Information

**Field name:** M19LB

**County:** Perry

**Location/Farm:** Dave McLaughlin

**Planting Date:** 6/14/2019

**Trial-type:** Intensive

#### Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

#### Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.4	0.3
Greenseeker R1 stage	0.8	0.7
Greenseeker R6 stage	NA	NA
Yield (bu/ac)	58.36	42.1

#### Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	5.2	5.0	6.2	6.1
Phosphorus (P) (ppm)	92.0	32.0	47.0	30.0
Potassium (K) (ppm)	204.0	73.0	246.0	91.0
Magnesium (Mg) (ppm)	71.0	85.0	123.0	91.0
Calcium (ppm)	971.3	836.3	1044.2	830.8
Acidity (meq/100 g)	6.3	6.3	3.4	2.8
CEC (meq/100 g)	12.3	11.4	10.3	7.9
Organic Matter %	4.5	2.8	4.2	4.0
Zinc (ppm)	6.8	2.9	4.1	3.3
Copper (ppm)	1.1	1.3	1.2	1.1
Sulfur (ppm)	13.8	11.5	10.4	9.6

% Saturation of the CEC for:				
K	4.3	1.60	6.10	2.9
Mg	4.8	6.2	10.0	9.5
Ca	39.6	36.8	50.8	52.3

### Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	22	16	60	0
Stunt	0	0	0	40
Spiral	88	66	0	40
Lance	66	116	0	0
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP

## Field Information

**Field name:** M19JB1

**Location/Farm:** Windy Ridge Dairy

**Trial-type:** Non-Intensive

**County:** Butler

**Planting Date:** 5/19/2019

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.3	0.3
Greenseeker R1 stage	0.8	0.7
Greenseeker R6 stage	0.8	0.8
Yield (bu/ac)	60.3	50.2

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.4	6.7	6.8	6.8
Phosphorus (P) (ppm)	134.0	116.0	59.0	111.0
Potassium (K) (ppm)	289.0	288.0	212.0	223.0
Magnesium (Mg) (ppm)	234.0	247.0	178.0	193.0
Calcium (ppm)	1463.0	1503.0	1164.8	1374.9
Acidity (meq/100 g)	2.8	2.0	2.0	0.0
CEC (meq/100 g)	12.8	12.3	9.9	9.1
Organic Matter %	4.1	3.7	4.7	4.2
Zinc (ppm)	4.6	3.3	3.5	2.9
Copper (ppm)	17.1	10.3	13.4	9.9
Sulfur (ppm)	11.7	12.8	8.8	10.6
% Saturation of the CEC for:				
K	5.8	6.00	5.50	6.3
Mg	15.2	16.7	15.1	17.8
Ca	57.1	61.0	59.1	75.9

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	120	70	337	262
Stunt	0	0	0	0
Spiral	0	40	0	0
Lance	0	10	0	0
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	D	A	D	D

### Nematode damage thresholds for soybean

Nematode	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

## Field Information

**Field name:** M19JB2

**County:** Beaver

**Location/Farm:** Smith's Incredibull Farm

**Planting Date:** 5/5/2019

**Trial-type:** Non-Intensive

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.2	0.2
Greenseeker R1 stage	0.6	0.6
Greenseeker R6 stage	0.8	0.8
Yield (bu/ac)	NA	NA

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.3	6.3	6.2	6.4
Phosphorus (P) (ppm)	36.0	43.0	17.0	17.0
Potassium (K) (ppm)	188.0	232.0	71.0	69.0
Magnesium (Mg) (ppm)	198.0	185.0	163.0	148.0
Calcium (ppm)	1025.0	1149.0	926.9	1063.0
Acidity (meq/100 g)	2.8	2.8	3.4	2.8
CEC (meq/100 g)	10.1	10.7	9.6	9.5
Organic Matter %	3.2	3.5	3.3	3.5
Zinc (ppm)	4.8	6.3	4.1	4.1
Copper (ppm)	1.4	2.0	1.4	1.8
Sulfur (ppm)	9.0	11.6	7.6	9.5
% Saturation of the CEC for:				
K	4.8	5.60	1.90	1.9
Mg	16.4	14.4	14.2	12.9
Ca	51.0	53.8	48.4	55.8

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	0	0	187	112
Stunt	0	40	0	0
Spiral	160	40	100	1350
Lance	0	0	0	0
Pin	0	0	0	0
Dagger	0	0	12	0
Ring	0	0	0	0
Soybean Cyst	0	0	100	0
Stubby root	0	0	0	0
Action Code	A	A	D and E	D

### Nematode damage thresholds for soybean

Nematode	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

## Field Information

**Field name:** M19AB

**County:** Snyder

**Location/Farm:** Dan Whitmer

**Planting Date:** 5/25/2019

**Trial-type:** Intensive

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.3	0.4
Greenseeker R1 stage	0.8	0.7
Greenseeker R6 stage	0.9	0.9
Yield (bu/ac)	88.2	67.6

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.0	6.4	6.6	6.4
Phosphorus (P) (ppm)	6.7	44.0	69.0	27.0
Potassium (K) (ppm)	74.0	123.0	276.0	138.0
Magnesium (Mg) (ppm)	216.0	111.0	136.0	118.0
Calcium (ppm)	1442.0	891.0	1423.6	986.4
Acidity (meq/100 g)	2.0	2.0	2.2	2.0
CEC (meq/100 g)	11.0	7.7	11.2	8.3
Organic Matter %	3.7	2.9	3.2	3.0
Zinc (ppm)	5.6	3.7	5.0	3.3
Copper (ppm)	1.8	1.4	2.0	1.5
Sulfur (ppm)	10.2	6.9	9.9	9.1
% Saturation of the CEC for:				
K	5.0	4.10	6.30	4.3
Mg	11.0	12.0	10.2	11.9
Ca	65.7	57.9	63.8	59.6

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	150	20	20	10
Stunt	0	0	40	0
Spiral	0	80	360	0
Lance	0	0	50	70
Pin	0	0	0	0
Dagger	0	0	10	40
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	D	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

## Field Information

**Field name:** M19CC

**County:** Lawrence

**Location/Farm:** Rick Telesz

**Planting Date:** 5/10/2019

**Trial-type:** Non-Intensive

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.2	0.2
Greenseeker R1 stage	0.9	0.8
Greenseeker R6 stage	0.8	0.8
Yield (bu/ac)	82	48

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.9	6.5	6.6	6.8
Phosphorus (P) (ppm)	90.0	74.0	68.0	44.0
Potassium (K) (ppm)	353.0	259.0	203.0	157.0
Magnesium (Mg) (ppm)	263.0	247.0	263.0	199.0
Calcium (ppm)	1208.0	833.0	997.9	976.8
Acidity (meq/100 g)	0.0	2.0	2.0	2.0
CEC (meq/100 g)	9.1	8.9	9.7	8.9
Organic Matter %	3.6	3.0	3.0	2.3
Zinc (ppm)	6.0	3.8	3.7	3.1
Copper (ppm)	2.4	1.5	1.9	1.6
Sulfur (ppm)	17.4	14.1	10.8	8.7
% Saturation of the CEC for:				
K	9.9	7.50	5.40	4.5
Mg	24.0	23.2	22.6	18.5
Ca	66.1	46.9	51.4	54.6

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	10	30	150	62
Stunt	0	0	500	150
Spiral	40	80	100	400
Lance	0	0	0	0
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	D	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP

## Field Information

**Field name:** M19JG

**County:** Lancaster

**Location/Farm:** Hershey

**Planting Date:** 4/30/2019

**Trial-type:** Non-Intensive

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.9	0.8
Greenseeker R1 stage	0.9	0.9
Greenseeker R6 stage	0.8	0.9
Yield (bu/ac)	N/A	N/A

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.5	6.6	7.1	6.5
Phosphorus (P) (ppm)	149.0	85.0	370.0	61.0
Potassium (K) (ppm)	279.0	271.0	227.0	131.0
Magnesium (Mg) (ppm)	171.0	140.0	147.0	104.0
Calcium (ppm)	1753.0	1144.0	2443.0	1036.4
Acidity (meq/100 g)	2.8	2.8	0.0	2.8
CEC (meq/100 g)	13.7	10.4	14.0	9.2
Organic Matter %	6.0	4.5	4.1	4.3
Zinc (ppm)	9.2	5.1	10.0	3.4
Copper (ppm)	18.9	14.3	12.2	10.0
Sulfur (ppm)	9.8	10.5	9.4	7.8
% Saturation of the CEC for:				
K	5.2	6.70	4.20	3.7
Mg	10.4	11.2	8.7	9.4
Ca	64.0	55.1	87.1	56.4

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	30	0	25	11
Stunt	40	40	0	0
Spiral	40	400	0	88
Lance	30	0	0	0
Pin	0	0	0	0
Dagger	0	0	12	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

## Field Information

**Field name:** M19CG

**Location/Farm:** Wellsboro, PA

**Trial-type:** Non-Intensive

**County:** Tioga

**Planting Date:** 5/22/2019

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.3	0.3
Greenseeker R1 stage	0.8	0.9
Greenseeker R6 stage	0.9	0.8
Yield (bu/ac)	N/A	N/A

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.9	6.9	7.4	7.0
Phosphorus (P) (ppm)	113.0	151.0	97.0	99.0
Potassium (K) (ppm)	172.0	246.0	174.0	164.0
Magnesium (Mg) (ppm)	73.0	89.0	80.0	86.0
Calcium (ppm)	2333.0	2100.0	2125.4	2341.6
Acidity (meq/100 g)	0.0	0.0	0.0	0.0
CEC (meq/100 g)	12.7	11.9	11.7	12.8
Organic Matter %	5.5	5.3	5.3	5.1
Zinc (ppm)	3.5	3.4	2.3	2.1
Copper (ppm)	1.6	1.2	1.4	1.1
Sulfur (ppm)	19.6	16.6	13.1	14.8
% Saturation of the CEC for:				
K	3.5	5.30	3.80	3.3
Mg	4.8	6.2	5.7	5.6
Ca	91.7	88.4	90.5	91.1

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	40	0	175	180
Stunt	0	0	0	0
Spiral	40	0	0	0
Lance	0	0	75	20
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

## Field Information

**Field name:** M19ZL1

**County:** Cambria

**Location/Farm:** Adam Hite

**Planting Date:** 5/2/2019

**Trial-type:** Intensive

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.2	0.1
Greenseeker R1 stage	0.8	0.4
Greenseeker R6 stage	0.9	0.8
Yield (bu/ac)	62	40

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.7	6.9	6.3	6.9
Phosphorus (P) (ppm)	108.0	77.0	79.0	71.0
Potassium (K) (ppm)	252.0	265.0	165.0	248.0
Magnesium (Mg) (ppm)	286.0	470.0	263.0	419.0
Calcium (ppm)	1178.0	2178.0	1009.4	1617.5
Acidity (meq/100 g)	2.0	0.0	2.8	0.0
CEC (meq/100 g)	10.9	15.5	10.5	12.2
Organic Matter %	4.3	4.6	3.8	4.1
Zinc (ppm)	2.0	2.8	1.5	1.9
Copper (ppm)	1.1	2.1	1.1	1.8
Sulfur (ppm)	7.7	9.1	7.9	7.3
% Saturation of the CEC for:				
K	5.9	4.40	4.00	5.2
Mg	21.8	25.3	20.9	28.6
Ca	53.9	70.3	48.2	66.2

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	30	0	400	10
Stunt	0	0	0	0
Spiral	0	320	50	0
Lance	0	0	0	60
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	D	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP

## Field Information

**Field name:** M19ZL2

**County:** Bedford

**Location/Farm:** David Hernley

**Planting Date:** 5/17/2019

**Trial-type:** Non-Intensive

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.2	0.2
Greenseeker R1 stage	0.7	0.6
Greenseeker R6 stage	0.9	0.8
Yield (bu/ac)	87	66

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	7.3	7.6	6.9	7.2
Phosphorus (P) (ppm)	98.0	62.0	50.0	37.0
Potassium (K) (ppm)	235.0	257.0	172.0	236.0
Magnesium (Mg) (ppm)	256.0	295.0	214.0	347.0
Calcium (ppm)	1818.0	3032.0	1456.6	3710.0
Acidity (meq/100 g)	0.0	0.0	0.0	0.0
CEC (meq/100 g)	11.8	18.1	9.5	18.5
Organic Matter %	3.4	4.4	3.0	4.1
Zinc (ppm)	3.0	2.9	1.8	2.4
Copper (ppm)	1.9	3.3	1.8	2.6
Sulfur (ppm)	7.5	8.8	6.8	8.5
% Saturation of the CEC for:				
K	5.1	3.60	4.60	3.3
Mg	18.0	13.6	18.8	15.6
Ca	76.9	82.8	76.6	81.1

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	40	0	37	12
Stunt	0	0	0	0
Spiral	0	0	50	100
Lance	10	0	0	0
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

## Field Information

**Field name:** M19AD

**Location/Farm:** Pine Grove

**Trial-type:** Intensive

**County:** Centre

**Planting Date:** NA

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	N/A	NA
Greenseeker R1 stage	N/A	NA
Greenseeker R6 stage	N/A	NA
Yield (bu/ac)	N/A	NA

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.9	7.3	6.4	7.2
Phosphorus (P) (ppm)	60.0	22.0	32.0	12.0
Potassium (K) (ppm)	219.0	243.0	171.0	223.0
Magnesium (Mg) (ppm)	126.0	287.0	120.0	230.0
Calcium (ppm)	1428.0	1960.0	1205.4	1586.8
Acidity (meq/100 g)	0.0	0.0	2.0	0.0
CEC (meq/100 g)	8.8	12.8	9.5	10.4
Organic Matter %	3.1	3.9	3.6	4.2
Zinc (ppm)	8.0	10.9	6.5	8.1
Copper (ppm)	3.9	5.6	3.3	4.1
Sulfur (ppm)	9.7	10.2	7.0	7.0
% Saturation of the CEC for:				
K	6.4	4.90	4.60	5.5
Mg	12.0	18.7	10.6	18.4
Ca	81.6	76.5	63.7	76.1

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	30	10	100	144
Stunt	0	0	50	0
Spiral	80	0	50	0
Lance	20	10	0	0
Pin	0	10	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	12	0
Action Code	A	A	D	D

### Nematode damage thresholds for soybean

Nematode	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

## Field Information

**Field name:** M19DV1

**Location/Farm:** Krall

**Trial-type:** Intensive

**County:** Lebanon

**Planting Date:** 5/1/2019

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.3	0.3
Greenseeker R1 stage	0.8	0.8
Greenseeker R6 stage	NA	NA
Yield (bu/ac)	NA	NA

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.7	6.5	6.8	6.9
Phosphorus (P) (ppm)	101.0	94.0	93.0	155.0
Potassium (K) (ppm)	251.0	360.0	280.0	289.0
Magnesium (Mg) (ppm)	94.0	133.0	137.0	116.0
Calcium (ppm)	1155.0	1232.0	1457.5	1722.4
Acidity (meq/100 g)	2.0	2.2	2.0	0.0
CEC (meq/100 g)	9.2	10.4	11.1	10.3
Organic Matter %	2.5	3.1	2.5	2.5
Zinc (ppm)	7.3	7.8	5.7	8.0
Copper (ppm)	2.7	2.9	3.0	3.3
Sulfur (ppm)	8.2	8.7	9.2	9.7
% Saturation of the CEC for:				
K	7.0	8.90	6.40	7.2
Mg	8.5	10.7	10.2	9.4
Ca	62.8	59.3	65.4	83.5

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	0	20	20	0
Stunt	0	0	0	0
Spiral	240	80	40	100
Lance	40	0	0	0
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	A	A

### Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

#### Damage Threshold

	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP

## Field Information

Field name: M19DV2

Location/Farm: Kreider

Trial-type: Intensive

County: Lebanon

Planting Date: 5/2/2019

## Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop health.
- Yield was recorded at harvest.

## Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.3	0.2
Greenseeker R1 stage	0.7	0.5
Greenseeker R6 stage	NA	NA
Yield (bu/ac)	NA	NA

## Soil nutrient profile

Parameter	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	7.1	6.4	5.9	6.5
Phosphorus (P) (ppm)	138.0	154.0	141.0	128.0
Potassium (K) (ppm)	213.0	435.0	294.0	174.0
Magnesium (Mg) (ppm)	204.0	177.0	120.0	136.0
Calcium (ppm)	1563.0	1138.0	972.5	1235.8
Acidity (meq/100 g)	0.0	2.4	5.1	2.2
CEC (meq/100 g)	10.1	11.7	11.7	10.0
Organic Matter %	3.9	5.0	3.9	4.0
Zinc (ppm)	16.6	16.3	11.2	11.6
Copper (ppm)	6.2	5.1	3.8	5.2
Sulfur (ppm)	7.2	9.7	10.8	7.5
% Saturation of the CEC for:				
K	5.4	9.50	6.40	4.5
Mg	16.9	12.6	8.5	11.4
Ca	77.7	48.7	41.5	62.0

## Soil nematode profile

Nematode	Pre-planting		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	90	0	25	112
Stunt	0	0	50	0
Spiral	0	40	750	2150
Lance	0	10	0	0
Pin	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Soybean Cyst	0	0	0	0
Stubby root	0	0	0	0
Action Code	A	A	A	D

### Nematode damage thresholds for soybean

Nematode	Nematodes per 500 cc soil		
	Low	Moderate	High
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold	
	Low
	Moderate
	High

#### Action Code(s) (if present)

- A: No expected harm to crop production
- B: Possible damage; consider chemical treatment
- C: Chemical treatment recommended
- D: Use of nematode-resistant variety recommended
- E: Rotate with nonhost crop(s)

\*Soybean is a host for both northern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15

## Slug Monitoring Trials

**Project Leader:** Dr. Liz Bosak (Dauphin and Perry Counties)

**Counties:** Bedford (Zach Larson), Bradford (Casey Guindon), Butler (Justin Brackenrich), Cambria (Zach Larson), Centre (Adriana Murillo-Williams), Dauphin (Liz Bosak), Franklin (Brittany Clark), Lebanon (Del Voight), Lancaster (Jeff Graybill), Mercer (Claire Coombs), Montgomery (Andrew Frankenfield), Perry (Liz Bosak), Potter (Nicole Santangelo), Union (Anna Busch), York (Heidi Reed)

**Number of overall sites:** 30

**Current update:** For the 2019 planting season, slug populations and slug damage were low across the State. Monitoring efforts were temporarily halted twenty one days after crop emergence at each site and resumed after harvest when possible.

The following are preliminary results from this growing season. Overall, slug populations have been low in the all but a few of the monitored fields. Because of this, it is very difficult to draw any conclusions about slug eggs, juvenile populations, and plant damage. What have we learned so far?

1. In 2018 and 2019, spring egg counts did not reflect the juvenile and adult numbers for every field. In 2019, the total egg counts ranged from 0 to 63 eggs per field. Out of the 46 times the fields were scouted for eggs, only 15 times were any eggs observed. Fields with higher egg counts did not have more plant damage compared to fields with no eggs observed.
2. Of all four slug species, marsh slugs were found most often in shingle traps in 2019. The second most common species was the gray garden.
3. In 2019, relatively low numbers of gray garden slugs were observed. In 2018, one field accounted for 92% of the gray garden slugs found for the season.
4. Most fields experienced little or no plant damage.

**Current extension activities include:**

- Weekly Field Crop News slug reports during the planting season. No reports were necessary in the fall.
- Project update presentations were given by Dr. Bosak at the Spruce Hill Grange Winter Farmers' meeting (Juniata County, March 12, 2019), Agronomic Pesticide Update meeting (Dauphin County, March 27, 2019), and at the Agronomic Pesticide Applicators School (Lancaster County, September 18, 2019).

## Good Inoculation Practice Trials

### Individual Trial Reports for Good Inoculation Practice Trials

#### Field Information

**Field Code:** YS

**Location/Farm:** Southeast Research and Extension Center, Landisville

**Planting Date:** 5/22/2019

**Trial Type:** Good Inoculation Practices

**County:** Lancaster

**Variety:** FBN 2.9

**Replications:** 6

#### Treatments

- 1- Untreated
- 2- Rhizobium
- 3- Rhizobium + Moly
- 4- Rhizobium + Azospirillum
- 5- Rhizobium + Moly + Azospirillum

Parameters	Untreated	Rhizobium	Rhizobium + Moly	Rhizobium + Azo	Rhizobium + Moly + Azo	Statistical significance
R2 Population (per acre)	144,232	142,296	149,072	150,040	155,848	Not Significant
R2 Height (inch)	22.4	22.3	22.8	21.9	21.7	Not Significant
R2 Nodulation	56	75	43	69	54	Not Significant
R2 SPAD meter readings	38.6	41.1	38.9	38.8	40.3	Not Significant
Yield (bu/ac)	95.5	94.3	92.6	94.3	99.8	Not Significant

**Comments:** Despite excellent yields there were no significant differences in any of the parameters of the study in 2019.

### Field Information

**Field Code:**

**Location/Farm:** Rock Springs, State College, PA

**Variety:**

**Replications:** 6

**County:** Centre

**Trial Type:** Good Inoculation Practices

**Planting Date:**

### Treatments

1- Untreated

2- Rhizobium

3- Rhizobium + Moly

4- Rhizobium + Azospirillum

5- Rhizobium + Moly + Azospirillum

Parameters	Untreated	Rhizobium	Rhizobium + Moly	Rhizobium + Azo	Rhizobium + Moly + Azo	Statistical significance
V1 Population (per acre)	123,130	124,291	118,483	127,776	133,003	Not Significant
V1 Height (inch)	3.88	3.52	3.66	3.78	3.66	Not Significant
V1 Nodulation	9	9	10	9	9	Not Significant

**Comments:** There were no significant differences between treatments. Yields were not reported to due to deer feeding damage late in the season.

### Field Information

**Field Code:**

**Location/Farm:** Ahern

**Variety:**

**Replications:** 4

**County:** Bradford

**Trial Type:** Good Inoculation Practices

**Planting Date:** 5/22/2019

### Treatments

1- Untreated

2- GIP- Azospirillum + Rhizobium + Molybdenum

3- Farmer Control – Various

<b>Parameters</b>	<b>Untreated</b>	<b>GIP</b>	<b>Farmer Control</b>	<b>Statistical Significance</b>
Plant population (per acre)	99,982	96800	93,900	Not Significant
Emergence Height (inch)	10	10.4	10.2	Not Significant
Nodulation	13	17	12	Not Significant
Yield (bu/ac)	36.8	37.3	38.6	Not Significant

**Comments:** While there is a trend in both nodulation counts and resulting yield toward utilizing GIP there is no statistical difference in treatments for this growing season.

### Field Information

**Field Code:**  
**Location/Farm:** Rock Springs  
**Variety:**  
**Replications:** 6

**County:** Centre  
**Trial Type:** Good Inoculation Practices  
**Planting Date:** 6/6/2019

### Treatments

- 1- Untreated
- 2- GIP- Azospirillum + Rhizobium + Molybdenum
- 3- Farmer Control – Various

<b>Parameters</b>	<b>Untreated</b>	<b>GIP</b>	<b>Farmer Control</b>	<b>Statistical Significance</b>
Plant population (per acre)	138,346	129,500	137,700	Not Significant
Emergence Height (inch)	5	5	5	Not Significant
Nodulation	15	16	15	Not Significant
Yield (bu/ac)	60	60	60	Not Significant

**Comments:** While there is a trend in both nodulation counts and resulting yield toward utilizing GIP there is no statistical difference in treatments for this growing season.

### Field Information

**Field Code:**

**Location/Farm:** Bowman

**Variety:**

**Replications:** 4

**County:** Franklin

**Trial Type:** Good Inoculation Practices

**Planting Date:**

### Treatments

1- Untreated

2- GIP- Azospirillum + Rhizobium + Molybdenum

3- Farmer Control – Various

<b>Parameters</b>	<b>Untreated</b>	<b>GIP</b>	<b>Farmer Control</b>	<b>Statistical Significance</b>
Plant population (per acre)	114,898	115,200	-	Not Significant
Emergence Height (inch)	8.7	8.5	-	Not Significant
Nodulation	11	14	-	Not Significant
Yield (bu/ac)	64.8	67.6	-	Not Significant

**Comments:** While there is a trend in both nodulation counts and resulting yield toward utilizing GIP there is no statistical difference in treatments for this growing season.

### Field Information

**Field Code:**

**Location/Farm:** Grumbine

**Variety:**

**Replications:** 4

**County:** Lebanon

**Trial Type:** Good Inoculation Practices

**Planting Date:** 5/18/2019

### Treatments

1- Untreated

2- GIP- Azospirillum + Rhizobium + Molybdenum

3- Farmer Control – Various

<b>Parameters</b>	<b>Untreated</b>	<b>GIP</b>	<b>Farmer Control</b>	<b>Statistical Significance</b>
Plant population (per acre)	85,856	87,600	-	Not Significant
Emergence Height (inch)	3.6	3.5	-	Not Significant
Nodulation	17	18	-	Not Significant
Yield (bu/ac)	73.9	77.6	-	Not Significant

**Comments:** While there is a trend in both nodulation counts and resulting yield toward utilizing GIP there is no statistical difference in treatments for this growing season.

## Deep Ripping in No-Tillage Environments Trials

### Individual Trial Reports for Deep Ripping in No-Tillage Environments Trials

#### Field Information

**Field Code:**

**Location/Farm:** SEAREC

**Variety:**

**Replications:** 6

**County:** Lancaster

**Trial Type:** Deep Ripping in No-Till

**Planting Date:** 5/28/2019 and 7/15/19

#### Treatments

Spring Rip vs. Unripped Control (May planting)

Summer Rip vs Unripped Control (July planting, Double Crop scenario, rip after small grain harvest)

#### Procedures and measurements

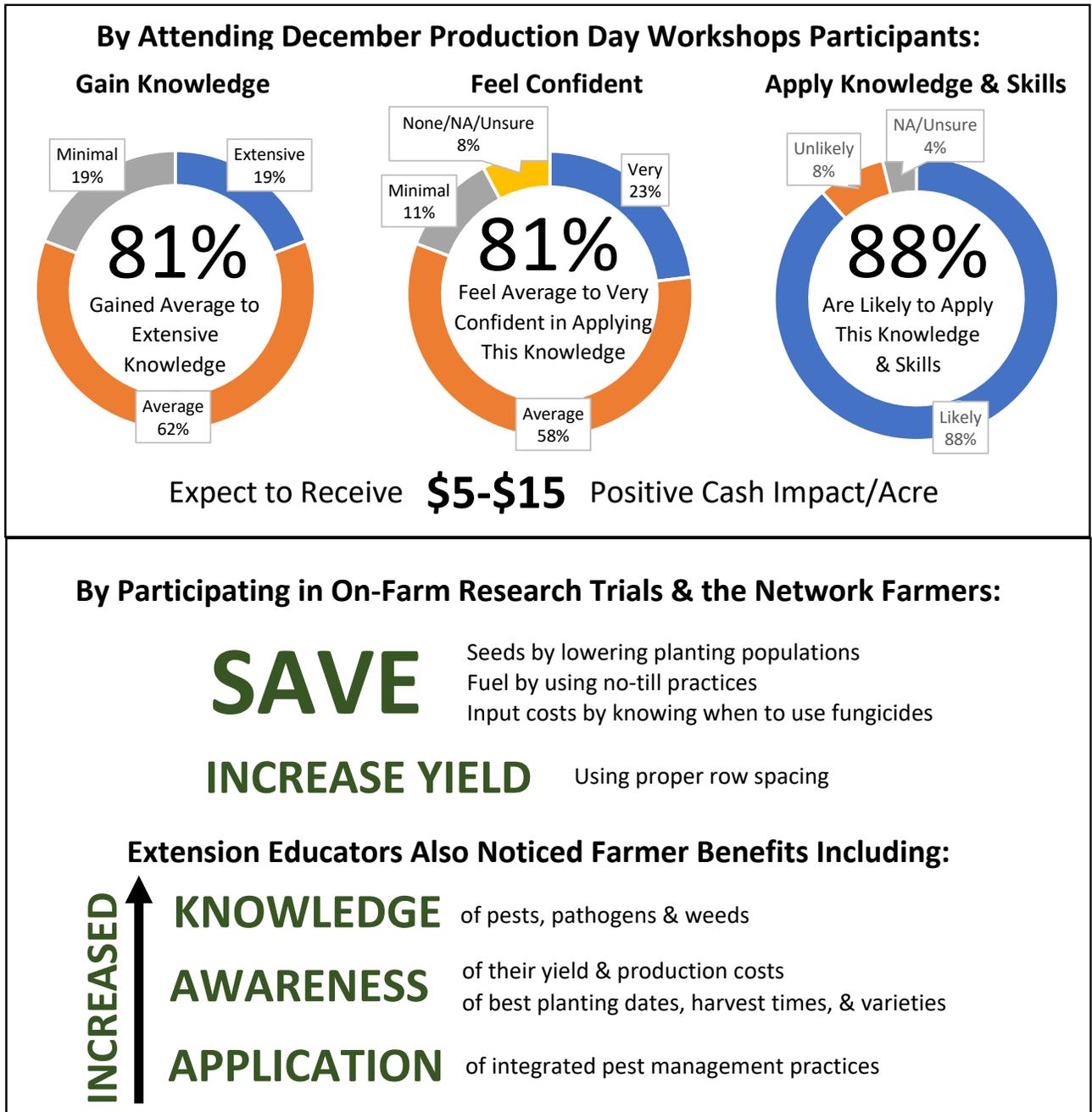
- Plots were ripped the day of planting in each scenario.
- Penetrometer readings were taken prior to ripping in early May and after ripping in early June with field conditions at field capacity for moisture.
- Population readings were conducted at V1 growth stage.
- Height data was collected at R1 and R3 to see if compaction limited plant growth.
- Yield was recorded at harvest.

#### Results

Parameter	Spring control	Spring Rip	Summer Control	Summer Rip	Statistical significance
Penetrometer Pre-ripping	13.7	13.4	15.4	14.2	Not Significant
Pop-up plant stand	66.2	70.4	99.9	105.7	Not Significant
Height R1	25.71	27.06	23.86	24.06	Not Significant
Height R3	37.50	37.39	NA	NA	Not Significant
Yield (bu/ac)	78.12	77.89	53.71	53.64	Not Significant

## 2019 PA Soybean On-Farm Network Evaluation Highlights

A formalized Evaluation Plan was developed in 2019 for the PA Soybean On-Farm Network to strategically understand program impacts, identify areas for improvement, and define future research objectives that capture the evolving needs of program participants. This Plan involved surveys after December Production Day Workshops, video interviews with several farmers participating in on-farm research trials, and end-of-year extension educator surveys. A summary of takeaways from the Evaluation are highlighted below.



Note: The 2019 workshop surveys for this evaluation plan were conducted at 2 of the 4 workshops, with results aggregated. The cash impact of the workshop was asked in a separate survey held at a 3<sup>rd</sup> workshop location.

## **Publications Related to the Soybean On-Farm Network:**

Ananda Bandara, Ryan Trexler, Dilooshi Weerasooriya, Terrence Bell, Paul Esker. Association between soil and root microbiomes and within-farm-spatial-variation of soybean yields: I. The bacterial perspective. American Phytopathological society meeting, Cleveland, Ohio, USA; August 03-07, 2019. Abstract: Phytopathology 109:S2.152.

Ananda Bandara, Dilooshi Weerasooriya, Brandon Wilt, Alyssa Collins, Paul Esker. Relationship between soil fungal densities and soil chemical properties in Pennsylvania. American Phytopathological society meeting, Cleveland, Ohio, USA; August 03-07, 2019. Abstract: Phytopathology 109:S2.30.

Ananda Bandara, Dilooshi Weerasooriya, Brandon Wilt, Alyssa Collins, Del Voight, Paul Esker. Effect of Apron Maxx seed treatment on soybean seedling diseases, seedling vigor, and yields in Pennsylvania. American Phytopathological society meeting, Cleveland, Ohio, USA; August 03-07, 2019. Abstract: Phytopathology 109:S2.60.

Ananda Bandara, Dilooshi Weerasooriya, Adriana Murillo-Williams, Alyssa Collins, Paul Esker. Association of selected biological and chemical properties of soil with within-farm-spatial-variation of soybean yields in Pennsylvania. American Phytopathological society meeting, Cleveland, Ohio, USA; August 03-07, 2019. Abstract: Phytopathology 109:S2.30.

Brandon Wilt, Ananda Bandara, Dilooshi Weerasooriya, Paul Esker. Impact of metalaxyl, ethaboxam, and mefenoxam on in-vitro growth rate of Pythium isolates from Pennsylvania. American Phytopathological society meeting, Cleveland, Ohio, USA; August 03-07, 2019. Abstract: Phytopathology 109:S2.60.