



## Integrated management of **Aphanomyces and Fusarium root rot** in field peas: (1) Impact of variety selection

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**Northern Pulse Growers Association**

**North Dakota Department of Agriculture** Pesticide Harmonization and Registration Board

**USDA Specialty Crop Block Grant Program** administered by the

North Dakota Department of Agriculture





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**Northern Pulse Growers Association**

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**USDA Specialty Crop Block Grant Program** administered by ND Department of Agriculture

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# Research methods:

## **Study design:**

Randomized studies with six replicates (randomized complete block with a split-split-plot arrangement, main factor = plant date, sub-factor = variety, sub-sub-factor = seed treatment)

Plots 5 ft x 30 ft at planting, 5 ft x approx. 20 ft at harvest.

Plots consist of 7 rows, each 7.5 or 7.0 inches apart

Seeding rate = 330,000 viable seeds/ac

## **Data collection:**

**Root rot:** assessed at early to mid vegetative growth (4-10 nodes). The percent of the epicotyl + top 2.5 cm of the tap root diseased; assessed on 16, 36, or 50 roots/plot, depending on study and planting date. Half of the roots were collected from each plot end outside of the area assessed for yield.

**Wilt:** assessed at mid to late pod-fill. A visual estimate of the percent of the plants exhibiting root rot associated wilt symptoms. This was always assessed at a consistent growth stage across field pea varieties within each planting date.

Within each study, every effort was made to assess root rot and wilt at a consistent growth stage across every planting date and every field pea variety.

**Yield:** moisture was assessed at harvest and yields are reported at a standard 13.5% moisture



# Fusarium and Aphanomyces root rot of field peas: Integrated Management

## Carrington, ND (2024) Study #1 Field 17

		Planting date #1		Planting date #2		Planting date #3		Planting date #4	
		Date: April 23-24		May 10		May 22		June 12-13	
		soil temperature: 45.2°F		60.3°F		56.4°F		67.6°F	
average soil temp. at seeding depth in the 1 <sup>st</sup> 7 days after planting		Wilted plants (%)		Wilted plants (%)		Wilted plants (%)		Wilted plants (%)	
		Yield (bu/ac)		Yield (bu/ac)		Yield (bu/ac)		Yield (bu/ac)	
Field pea variety	Fungicide seed treatment	80-97% pods fully filled	13.5% moisture	75-90% pods fully filled	13.5% moisture	85-100% pods fully filled	13.5% moisture	40-85% pods fully filled	13.5% moisture
AAC IronHorse	Non-treated seed	3 a*	69 a*	18 a*	42 a*	30 a*	38 a*	55 a*	14 b*
AAC IronHorse	Obvius, 4.6 fl oz/cwt	2 a	85 a	13 a	50 a	25 a	44 a	58 a	14 b
AAC IronHorse	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	3 a	85 a	17 a	54 a	24 a	37 a	59 a	13 b
AAC IronHorse	Vibrance Total, 5 fl oz/cwt	3 a	77 a	15 a	50 a	23 a	45 a	44 a	17 a
AAC IronHorse	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	3 a	73 a	12 a	50 a	23 a	42 a	37 a	19 a
CV: 47.1		14.6	36.1	14.1	28.8	20.4	59.8	13.3	
AAC Julius	Non-treated seed	10 a*	74 a*	27 a*	36 a*	57 a*	18 a*	71 b*	12 bc*
AAC Julius	Obvius, 4.6 fl oz/cwt	8 a	77 a	22 a	42 a	53 a	25 a	72 b	12 bc
AAC Julius	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	10 a	80 a	26 a	41 a	57 a	19 a	72 b	12 c
AAC Julius	Vibrance Total, 5 fl oz/cwt	8 a	87 a	23 a	44 a	47 a	25 a	65 ab	16 ab
AAC Julius	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	6 a	83 a	20 a	45 a	45 a	26 a	58 a	17 a
CV: 44.8		10.9	25.6	19.0	19.0	31.8	11.2	17.5	
ND Dawn	Non-treated seed	10 b*‡	73 a*	41 a*	31 b*	44 a*	29 a*	58 a*	15 a*
ND Dawn	Obvius, 4.6 fl oz/cwt	5 a	79 a	39 a	41 a	47 a	27 a	62 a	14 a
ND Dawn	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	6 ab	74 a	38 a	38 ab	46 a	28 a	65 a	13 a
ND Dawn	Vibrance Total, 5 fl oz/cwt	5 a	77 a	29 a	43 a	36 a	32 a	59 a	17 a
ND Dawn	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	5 a	79 a	31 a	42 a	36 a	33 a	58 a	18 a
CV: 20.8		7.1	23.2	14.5	30.8	24.6	17.8	20.9	
Caphorn	Non-treated seed	20 b*	67 a*	78 c*	23 a*	78 ab*	10 ab*	84 a*	4 a*
Caphorn	Obvius, 4.6 fl oz/cwt	9 ab	71 a	64 b	25 a	73 ab	10 ab	88 a	4 a
Caphorn	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	9 ab	78 a	68 bc	24 a	83 b	8 b	84 a	3 a
Caphorn	Vibrance Total, 5 fl oz/cwt	8 a	74 a	54 a	26 a	73 ab	13 ab	89 a	4 a
Caphorn	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	8 a	72 a	53 a	32 a	65 a	16 a	76 a	6 a
CV: 60.9		9.9	11.0	27.3	10.6	36.4	17.6	59.8	
AAC Profit	Non-treated seed	47 b*	50 b*	89 b*	10 c*	80 b*	10 a*	90 ab*	2 b*
AAC Profit	Obvius, 4.6 fl oz/cwt	33 ab	47 b	80 ab	15 abc	82 b	10 a	90 ab	3 b
AAC Profit	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	33 ab	51 b	83 ab	14 bc	86 b	8 a	91 b	2 b
AAC Profit	Vibrance Total, 5 fl oz/cwt	28 a	70 a	80 ab	20 ab	76 ab	9 a	88 ab	3 a
AAC Profit	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	24 a	59 ab	69 a	21 a	63 a	16 a	78 a	5 a
CV: 29.2		14.7	10.4	25.0	10.2	38.2	8.3	33.7	
LG Amigo	Non-treated seed	72 b*	27 a*	96 b*	6 b*	95 b*	4 a*	66 a*	4 a*
LG Amigo	Obvius, 4.6 fl oz/cwt	51 a	37 a	88 b	8 ab	88 b	9 a	65 a	5 a
LG Amigo	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	60 ab	30 a	91 b	6 b	95 b	6 a	59 a	6 a
LG Amigo	Vibrance Total, 5 fl oz/cwt	52 ab	39 a	83 ab	10 ab	86 b	6 a	66 a	6 a
LG Amigo	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	56 ab	39 a	68 a	12 a	66 a	8 a	59 a	9 a
CV: 19.9		26.5	10.2	38.4	9.5	61.0	11.8	39.7	

Seeding rate = 330,000 viable seeds/ac Row spacing = 7.5 inches



# Fusarium and Aphanomyces root rot of field peas: Integrated Management

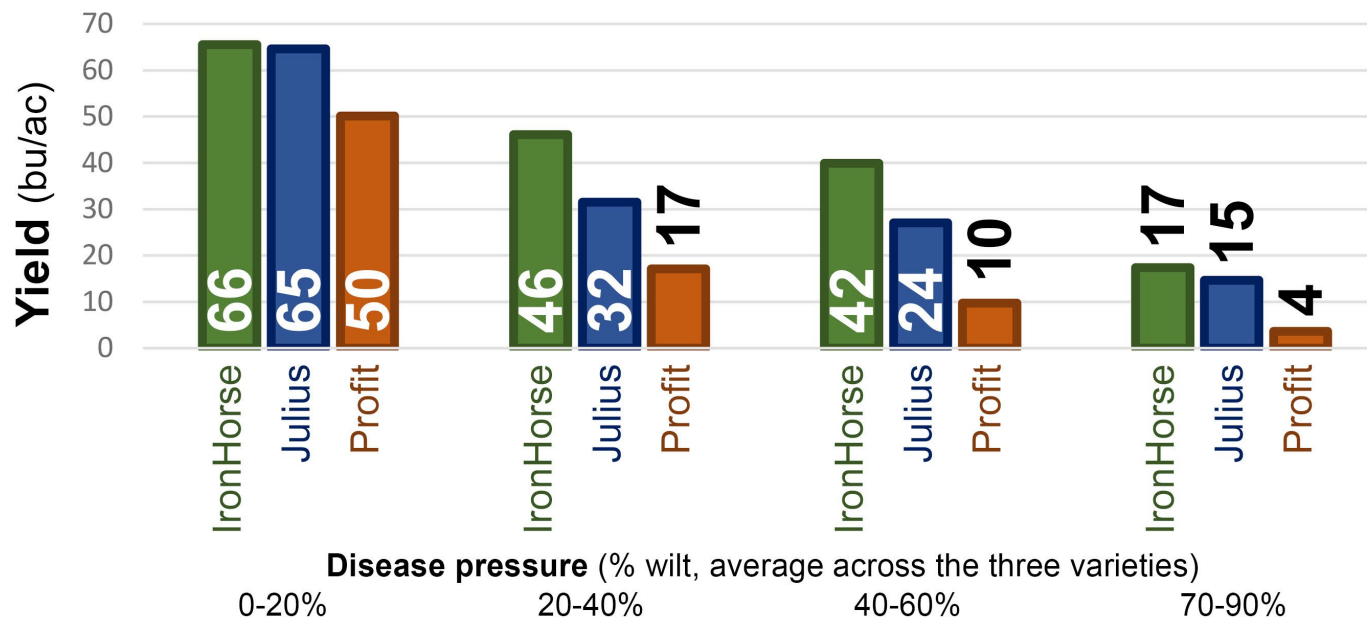
Carrington, ND (2024)

## Study #2 Field 18 south

		Planting date #1		Planting date #2		Planting date #3		Planting date #4	
		Date: April 23		May 12		May 22		June 12	
		soil temperature: 45.8°F		58.6°F		55.3°F		67.0°F	
average soil temp. at seeding depth in the 1 <sup>st</sup> 7 days after planting		Wilted plants (%)		Wilted plants (%)		Wilted plants (%)		Wilted plants (%)	
		Yield (bu/ac)		Yield (bu/ac)		Yield (bu/ac)		Yield (bu/ac)	
Field pea variety	Fungicide seed treatment	85-100% pods fully filled	13.5% moisture	70-100% pods fully filled	13.5% moisture	85-100% pods fully filled	13.5% moisture	78-100% pods fully filled	13.5% moisture
AAC IronHorse	Non-treated seed	3 a*	62 a*	6 a*	47 a*	7 a*	45 a*	78 a*	21 b*
AAC IronHorse	Obvius, 4.6 fl oz/cwt	1 a	69 a	6 a	43 a	7 a	45 a	73 a	24 ab
AAC IronHorse	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	2 a	68 a	8 a	44 a	9 a	46 a	77 a	21 b
AAC IronHorse	Vibrance Total, 5 fl oz/cwt	2 a	65 a	4 a	44 a	6 a	44 a	73 a	25 ab
AAC IronHorse	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	1 a	65 a	3 a	45 a	5 a	45 a	69 a	25 a
CV: 62.8		7.9		58.6	9.8	35.2	7.0	12.5	11.2
AAC Julius	Non-treated seed	3 a*	55 a*	17 b*	31 a*	20 a*	32 b*	92 a*	17 c*
AAC Julius	Obvius, 4.6 fl oz/cwt	5 a	60 a	10 ab	34 a	28 a	31 b	92 a	18 bc
AAC Julius	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	6 a	57 a	13 ab	33 a	24 a	32 b	92 a	17 bc
AAC Julius	Vibrance Total, 5 fl oz/cwt	2 a	58 a	7 a	35 a	19 a	35 ab	86 a	20 ab
AAC Julius	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	1 a	61 a	7 a	35 a	21 a	38 a	85 a	23 a
CV: 113.7		6.6		46.6	14.1	28.4	8.5	6.8	9.7
ND Dawn	Non-treated seed	5 a*	49 a*	14 a*	36 a*	21 a*	32 b*	93 ab*	19 b*
ND Dawn	Obvius, 4.6 fl oz/cwt	2 a	59 a	11 a	40 a	13 a	39 a	94 b	19 b
ND Dawn	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	2 a	59 a	13 a	42 a	15 a	38 ab	94 b	18 b
ND Dawn	Vibrance Total, 5 fl oz/cwt	3 a	55 a	15 a	34 a	17 a	37 ab	88 ab	24 a
ND Dawn	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	3 a	59 a	10 a	37 a	11 a	39 ab	88 a	25 a
CV: 96.0		11.6		44.4	13.9	40.4	11.2	4.2	12.2
Caphorn	Non-treated seed	14 a*	58 a*	34 a*	28 a*	36 b*	26 b*	94 b*	9 b*
Caphorn	Obvius, 4.6 fl oz/cwt	13 a	58 a	24 a	32 a	30 ab	30 ab	88 ab	12 ab
Caphorn	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	19 a	56 a	25 a	33 a	30 ab	28 b	94 ab	10 b
Caphorn	Vibrance Total, 5 fl oz/cwt	14 a	58 a	26 a	31 a	24 ab	31 ab	84 ab	12 b
Caphorn	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	14 a	57 a	23 a	34 a	21 a	34 a	82 a	16 a
CV: 39.0		7.6		25.9	14.5	26.7	11.0	8.7	17.5
AAC Profit	Non-treated seed	24 b*	50 a*	55 b*	19 c*	65 b*	16 c*	99 a*	4 b*
AAC Profit	Obvius, 4.6 fl oz/cwt	13 ab	55 a	42 ab	26 b	57 ab	18 bc	97 a	5 ab
AAC Profit	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	20 ab	51 a	41 ab	23 bc	63 b	17 c	99 a	4 b
AAC Profit	Vibrance Total, 5 fl oz/cwt	11 ab	54 a	33 a	26 b	47 a	23 ab	95 a	6 ab
AAC Profit	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	9 a	53 a	30 a	30 a	42 a	24 a	96 a	7 a
CV: 42.6		7.4		19.9	14.3	16.6	13.8	2.9	32.8
LG Amigo	Non-treated seed	28 a*	12 b*	44 b*	10 a*	61 b*	7 b*	92 ab*	5 bc*
LG Amigo	Obvius, 4.6 fl oz/cwt	22 a	19 a	38 ab	10 a	59 b	8 ab	92 ab	5 bc
LG Amigo	Obvius, 4.6 fl oz/cwt + Relenya, 0.4 fl oz/cwt	22 a	21 a	36 ab	10 a	68 b	7 b	96 b	5 c
LG Amigo	Vibrance Total, 5 fl oz/cwt	16 a	23 a	24 a	11 a	57 b	10 ab	86 a	7 b
LG Amigo	Vibrance Total, 5 fl oz + Trebuset, 0.614 fl oz/cwt	14 a	21 a	24 a	12 a	37 a	11 a	86 a	10 a
CV: 63.7		16.2		24.9	17.7	17.1	21.4	6.6	18.3

Seeding rate = 330,000 viable seeds/ac Row spacing = 7.5 inches

# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection



## Carrington, ND (2024)

Results across 2 studies, 4 plant dates/study (April 23-June 13)

### Seeding rate:

330,000 viable seeds/ac

Row spacing = 7.5 inches

Wilt was assessed at late pod-fill.

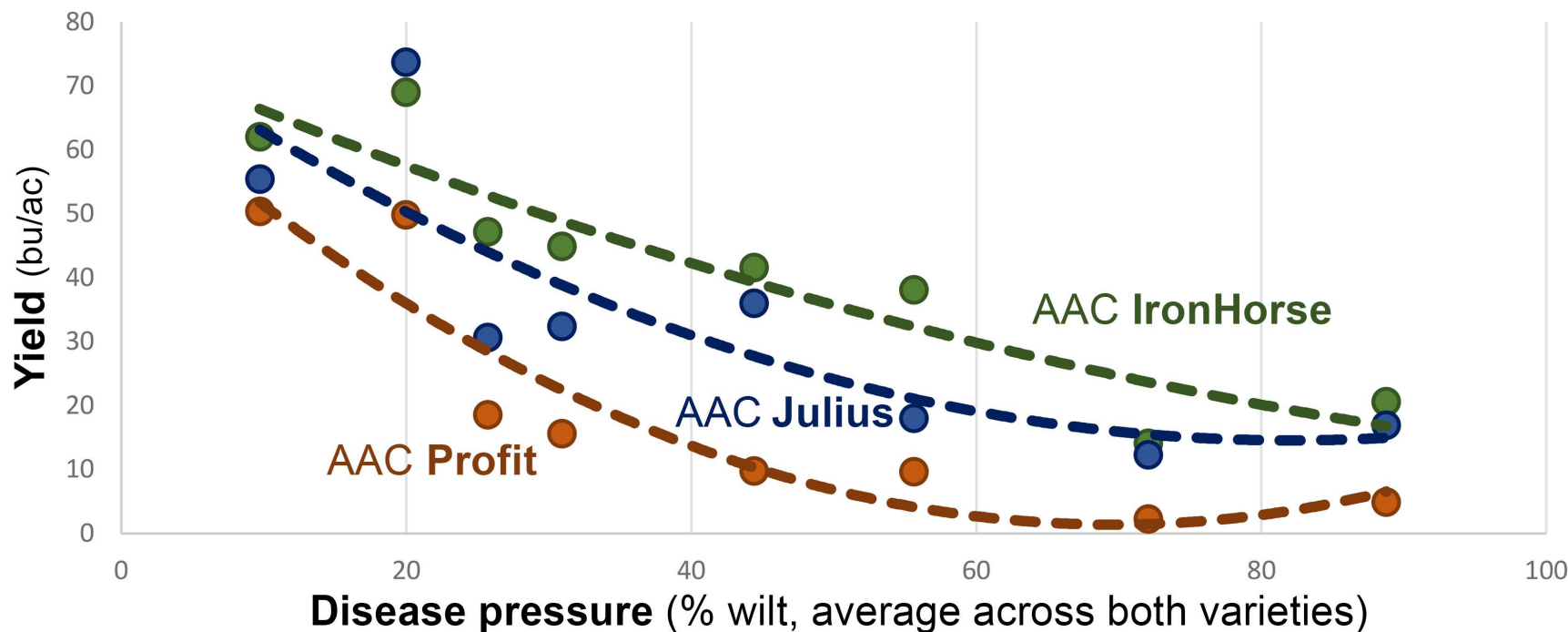
Visual estimate of the percent of the plants exhibiting wilt symptoms.

Plant date #1: 80-100% pods fully filled

Plant date #2: 70-100% pods fully filled

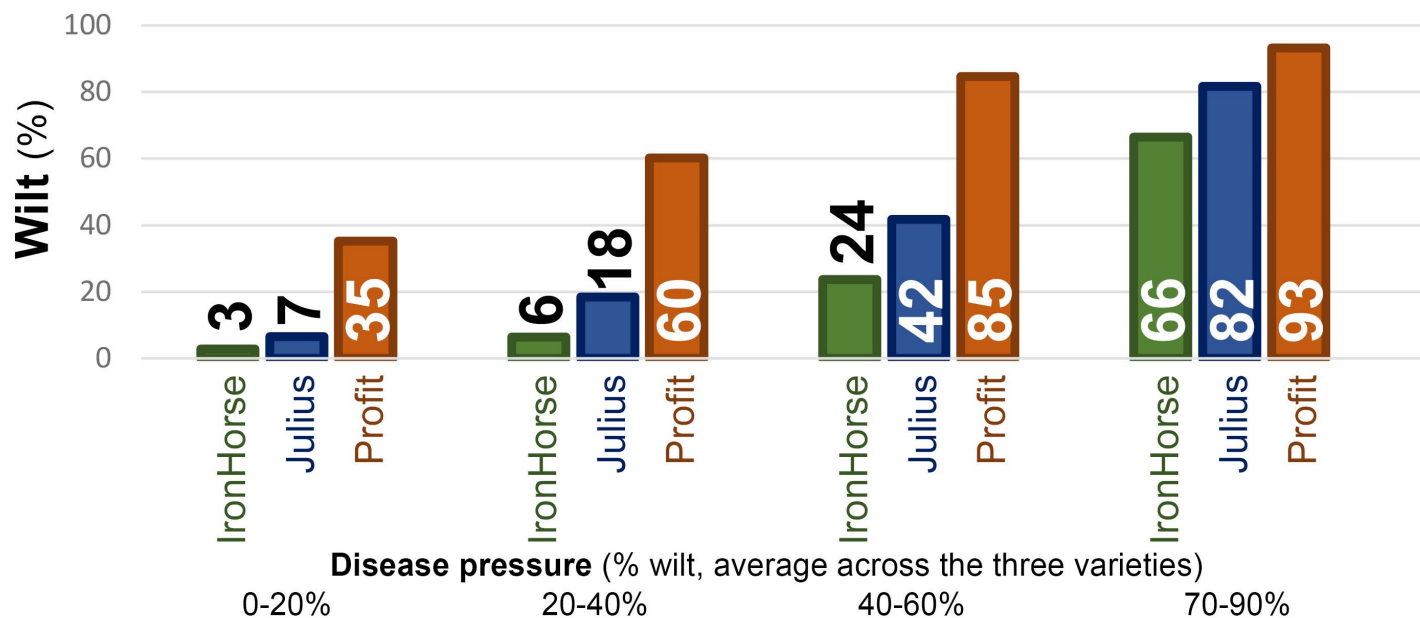
Plant date #3: 85-100% pods fully filled

Plant date #4: 40-100% pods fully filled





# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection



**Carrington, ND (2024)**

Results across 2 studies, 4 plant dates/study (April 23-June 13)

**Seeding rate:**

330,000 viable seeds/ac

**Row spacing = 7.5 inches**

Wilt was assessed at late pod-fill.

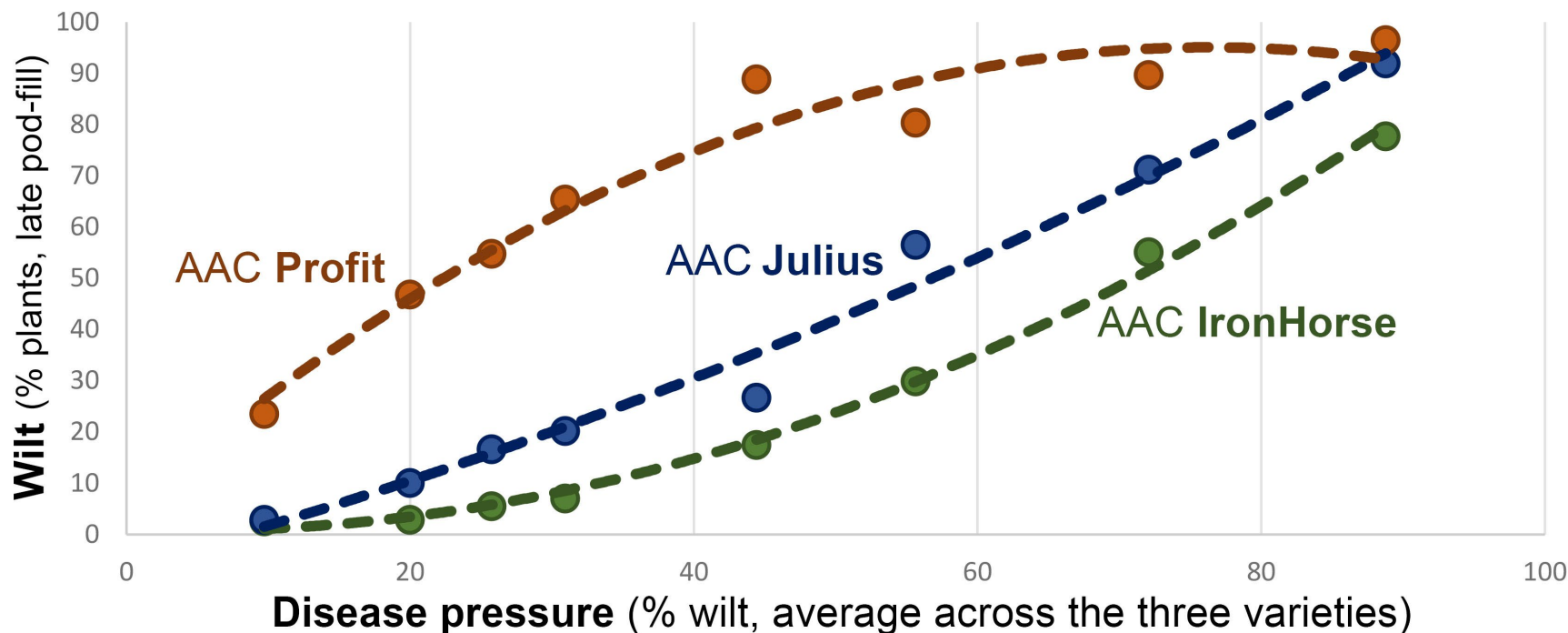
Visual estimate of the percent of plants exhibiting wilt symptoms.

Plant date #1: 80-100% pods fully filled

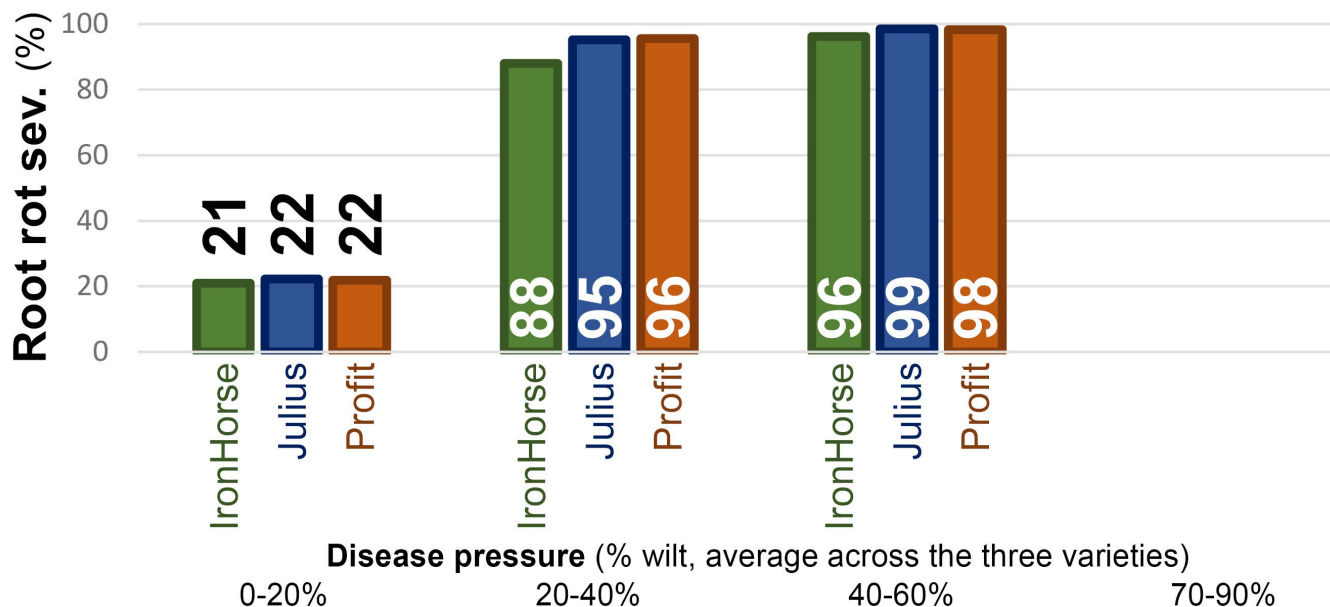
Plant date #2: 70-100% pods fully filled

Plant date #3: 85-100% pods fully filled

Plant date #4: 40-100% pods fully filled



# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection



## Carrington, ND (2024)

Results across 2 studies, 4 plant dates/study (April 23-June 13)

**Seeding rate:**

330,000 viable seeds/ac

**Row spacing** = 7.5 inches

Root rot was assessed at early/mid vegetative growth.

Percent of the epicotyl plus first 2.5 cm of the tap root exhibiting yellow-brown cortical decay characteristic of Aphanomyces root rot and necrosis characteristic of Fusarium root rot

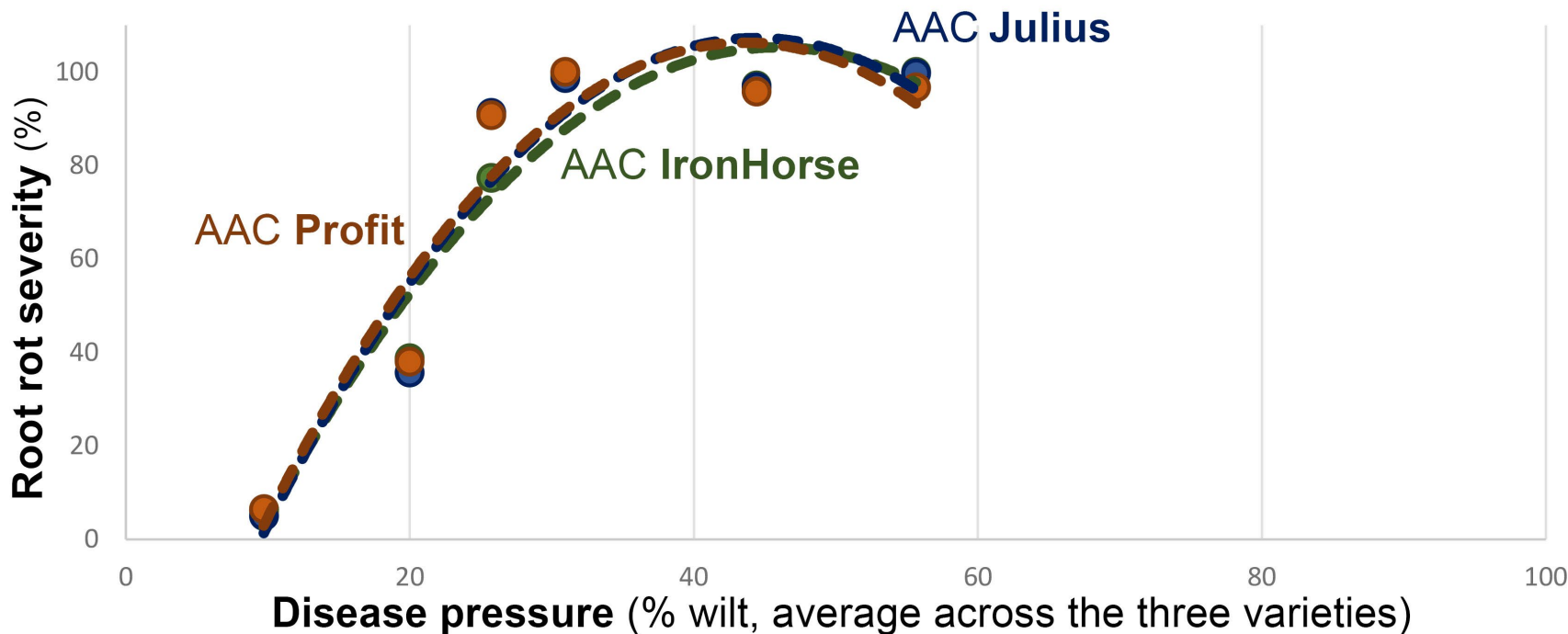
Plant date #1: 4-6 nodes

Plant date #2: 6-8 nodes

Plant date #3: 5-9 nodes

Plant date #4: root rot not assessed

Sample size = 36 plants/plot x 6 replicates (plant dates #1, #2); 16 plants/plot x 6 replicates (plant date #3)





## Fusarium and Aphanomyces root rot of field peas: **Impact of variety selection**

Pathogen diagnostic testing for studies conducted in 2024 is in progress.

Diagnostic testing results from the same field where study #2 was conducted in 2024:

	Field: F18 south	F18 north	F18 north
Last year seeded to peas:	<b>2015</b>	<b>2020</b>	<b>2019</b>
Years out of peas:	<b>7</b>	<b>2</b>	<b>3</b>
<b><i>Aphanomyces euteiches</i></b> (thousand DNA copies/gram of root)			
AAC <b>Julius</b> , non-treated	<b>25260</b>	<b>16818</b>	<b>10670</b>
AAC <b>Profit</b> , non-treated	<b>751</b>	<b>10563</b>	<b>957</b>
<b><i>Fusarium oxysporum</i></b> (thousand DNA copies/gram of root)			
AAC <b>Julius</b> , non-treated	<b>0</b>	<b>1.9</b>	<b>0</b>
AAC <b>Profit</b> , non-treated	<b>0</b>	<b>0</b>	<b>0</b>
<b><i>Fusarium avenaceum</i></b> (thousand DNA copies/gram of root)			
AAC <b>Julius</b> , non-treated	<b>0</b>	<b>0</b>	<b>0</b>
AAC <b>Profit</b> , non-treated	<b>0</b>	<b>0</b>	<b>0</b>

### Carrington, ND (2023)

- Diagnostic qPCR testing conducted by the National Agriculture Genotyping Center.
- Results 3 studies conducted on Field 18. Each study was conducted with 3 or 4 planting dates (June 22-June 9).
- Results represent the average across four qPCR tests per study (one per planting date). Each test represents a combined sample of six 1-cm long epicotyl segments, one collected from each of the six experimental replicates. The 1-cm long epicotyl segments were collected from a plant with root rot symptoms typical of that plot. Testing was only conducted on plants grown from non-treated seed.

# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Carrington, ND (2024):

Vascular necrosis characteristic of *Fusarium oxysporum* wilt was observed only at low levels

## Vascular necrosis

% of plants with vascular discoloration typical of *F. oxysporum* wilt

	Field 17	Field 18 south	
planting date 1	5-6 nodes	4-5 nodes	
planting date 2	6-8 nodes	6-8 nodes	
planting date 3	7-9 nodes	~5-8 nodes	
<b>AAC IronHorse</b>	<b>1.8</b> ab	<b>1.1</b> a	<b>1.5</b> a
<b>AAC Julius</b>	<b>4.4</b> c	<b>1.9</b> a	<b>3.2</b> a
<b>ND Dawn</b>	<b>1.6</b> ab	<b>0.8</b> a	<b>1.2</b> a
<b>Caphorn</b>	<b>2.0</b> ab	<b>0.9</b> a	<b>1.5</b> a
<b>AAC Profit</b>	<b>3.1</b> bc	<b>1.3</b> a	<b>2.2</b> a
<b>LG Amigo</b>	<b>0.9</b> a	<b>1.2</b> a	<b>1.1</b> a

$F, P>F:$  7.01, < 0.0001

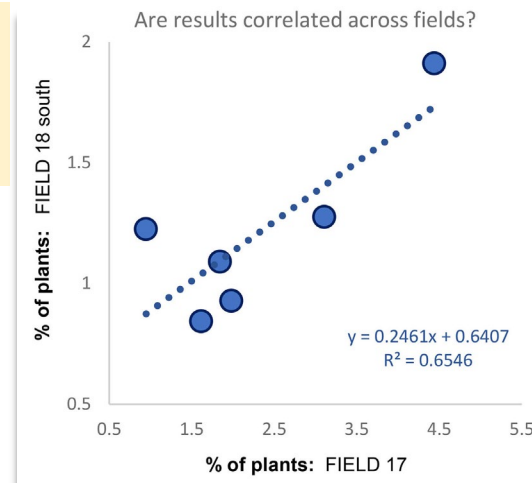
0.86, 0.5128

2.64, 0.1552

CV: 130.4

233.4

38.8



SAMPLE SIZE USED FOR ANALYSIS:

Plant date #1: 36 roots/plot across 6 replicates

Plant date #2: 36 roots/plot across 6 replicates

Plant date #3: 16 roots/plot across 6 replicates

Plant date #4: vascular necrosis not assessed



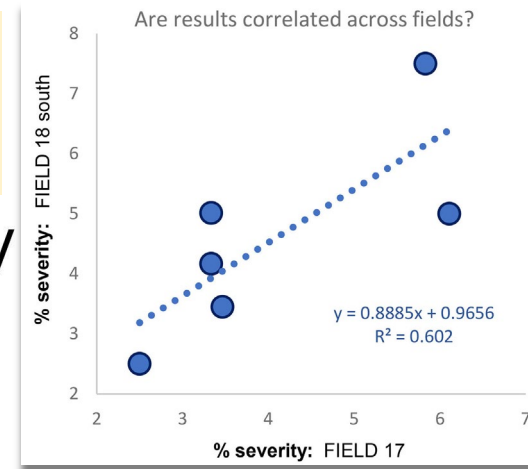
# Fusarium and Aphanomyces root rot of field peas: **Impact of variety selection**

Carrington, ND (2024):

*Fusarium* spp. was only isolated from vascular tissues at low levels, suggesting *F. oxysporum* wilt pressure was not high

## Fusarium vascular wilt microbiological assay

% stem sections from which *Fusarium* spp. isolated from vascular tissues



	Field 17	Field 18 south	
planting date 1	5-6 nodes	4-5 nodes	
planting date 2	6-8 nodes	6-8 nodes	
planting date 3	7-9 nodes	~5-8 nodes	<b>Combined analysis</b>
<b>AAC IronHorse</b>	<b>6</b>	<b>8</b>	<b>7 b</b>
<b>AAC Julius</b>	<b>3</b>	<b>3</b>	<b>3 a</b>
<b>ND Dawn</b>	<b>6</b>	<b>5</b>	<b>6 ab</b>
<b>Caphorn</b>	<b>3</b>	<b>4</b>	<b>4 ab</b>
<b>AAC Profit</b>	<b>3</b>	<b>3</b>	<b>3 ab</b>
<b>LG Amigo</b>	<b>3</b>	<b>5</b>	<b>4 ab</b>

$F, P>F:$

CV:

7.65, 0.0217

17.8

SAMPLE SIZE USED FOR ANALYSIS:

Plant date #1: 10 roots/plot across 6 replicates

Plant date #2: 10 roots/plot across 6 replicates

Plant date #3: not assessed

Plant date #4: not assessed

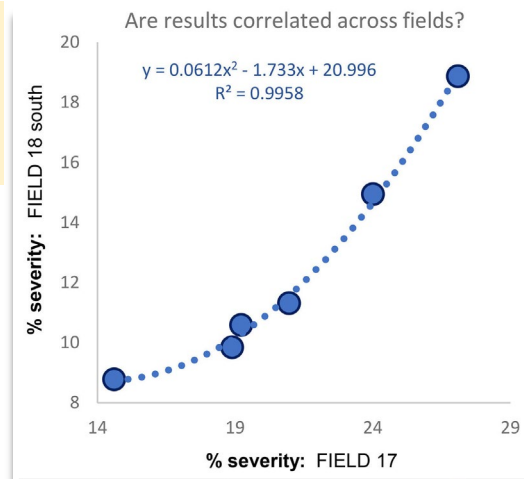
# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Carrington, ND (2024):

Varieties differed in severity of Fusarium root rot symptoms but these differences do not explain agronomic performance

## Fusarium root rot

% of epicotyl and top 1-in. of tap root with symptoms of Fusarium root rot



	Field 17	Field 18 south
planting date 1	5-6 nodes	4-5 nodes
planting date 2	6-8 nodes	6-8 nodes
planting date 3	7-9 nodes	~5-8 nodes

### Combined analysis

AAC IronHorse	19 ab	10 a	14 ab
AAC Julius	27 b	19 b	23 d
ND Dawn	21 ab	11 ab	16 bc
Caphorn	19 ab	11 ab	15 ab
AAC Profit	24 ab	15 ab	19 cd
LG Amigo	15 a	9 a	12 a

SAMPLE SIZE USED FOR ANALYSIS:

Plant date #1: 36 roots/plot across 6 replicates

Plant date #2: 36 roots/plot across 6 replicates

Plant date #3: 16 roots/plot across 6 replicates

Plant date #4: vascular necrosis not assessed

$F, P>F:$  3.52, 0.0066 3.03, 0.0166 35.70, 0.0006

CV: 58.4 67.5 5.7



# Fusarium and Aphanomyces root rot of field peas: **Impact of variety selection**

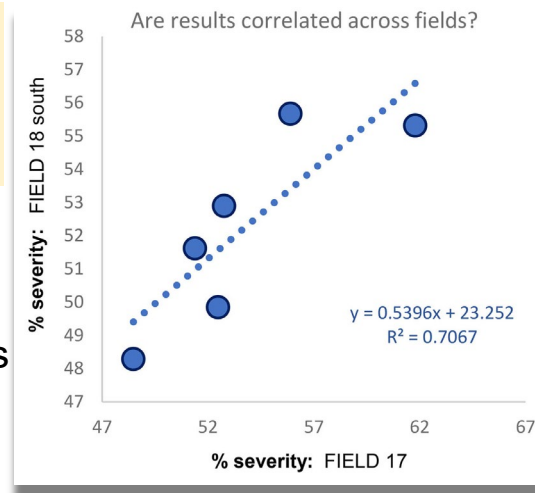
Carrington, ND (2024):

Symptoms characteristic of Aphanomyces root rot were predominant. Differences in tolerance drove yield response.

## Aphanomyces root rot

% of epicotyl and top 1-in. of tap root with Aphanomyces root rot symptoms

	Field 17	Field 18 south	
planting date 1	5-6 nodes	4-5 nodes	
planting date 2	6-8 nodes	6-8 nodes	
planting date 3	7-9 nodes	~5-8 nodes	
<b>AAC IronHorse</b>	<b>56</b> ab	<b>56</b> a	<b>56</b> ab
<b>AAC Julius</b>	<b>48</b> a	<b>48</b> a	<b>48</b> a
<b>ND Dawn</b>	<b>53</b> ab	<b>53</b> a	<b>53</b> ab
<b>Caphorn</b>	<b>51</b> ab	<b>52</b> a	<b>52</b> ab
<b>AAC Profit</b>	<b>52</b> ab	<b>50</b> a	<b>51</b> ab
<b>LG Amigo</b>	<b>62</b> b	<b>55</b> a	<b>59</b> b
<i>F, P&gt;F:</i>	3.10, 0.0134	1.26, 0.2934	7.48, 0.0227
<i>CV:</i>	26.4	19.4	3.5

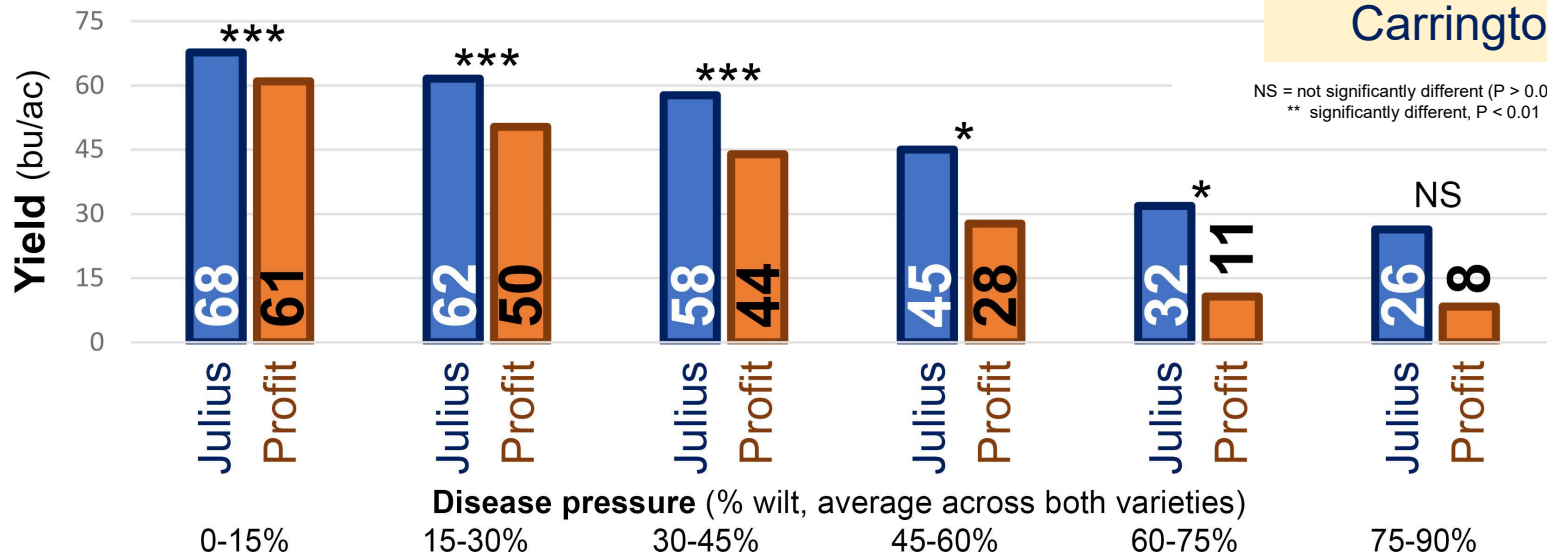


SAMPLE SIZE USED FOR ANALYSIS:

Plant date #1: 36 roots/plot across 6 replicates  
Plant date #2: 36 roots/plot across 6 replicates  
Plant date #3: 16 roots/plot across 6 replicates  
Plant date #4: vascular necrosis not assessed

# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Carrington, ND (2023)



**Results across 11 studies**, 4 plant dates/study (May 22 - June 9)

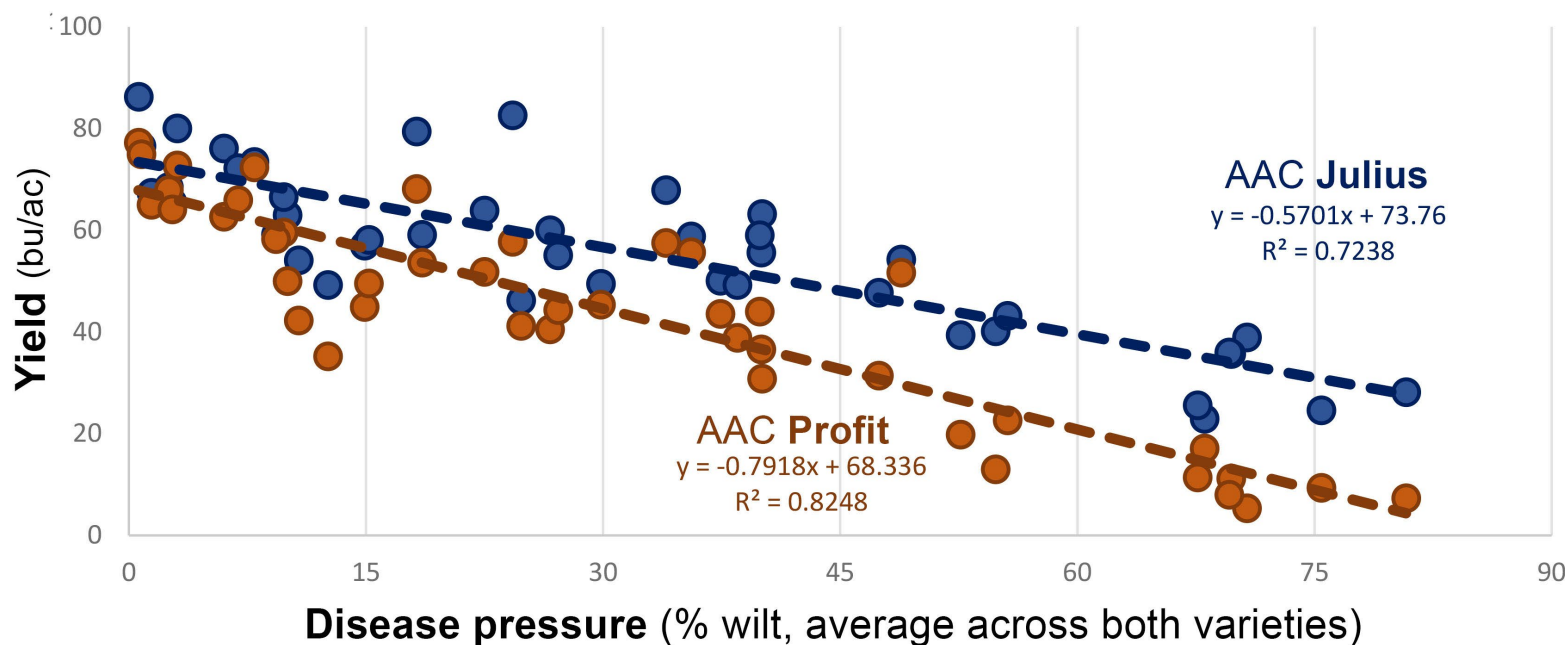
**Seeding rate:** 330,000 viable seeds/ac

**Row spacing** = 7.5 inches

Wilt was assessed during pod-fill.

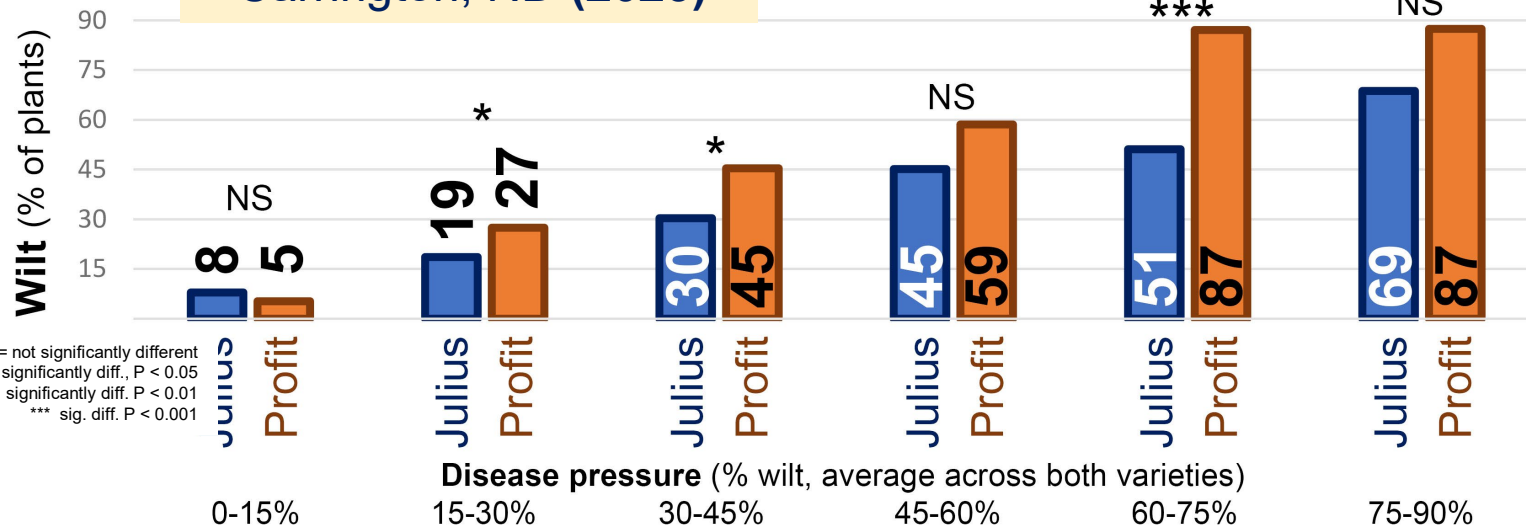
Visual estimate of the percent of the plants exhibiting wilt symptoms.

Plant date #1: 16-45% pods fully filled  
Plant date #2: 16-71% pods fully filled  
Plant date #3: 32-75% pods fully filled  
Plant date #4: 28-91% pods fully filled



# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

## Carrington, ND (2023)



**Results across 11 studies, 4 plant dates/study (May 22 - June 9)**

**Seeding rate:**  
330,000 viable seeds/ac

**Row spacing = 7.5 inches**

Wilt was assessed during pod-fill.

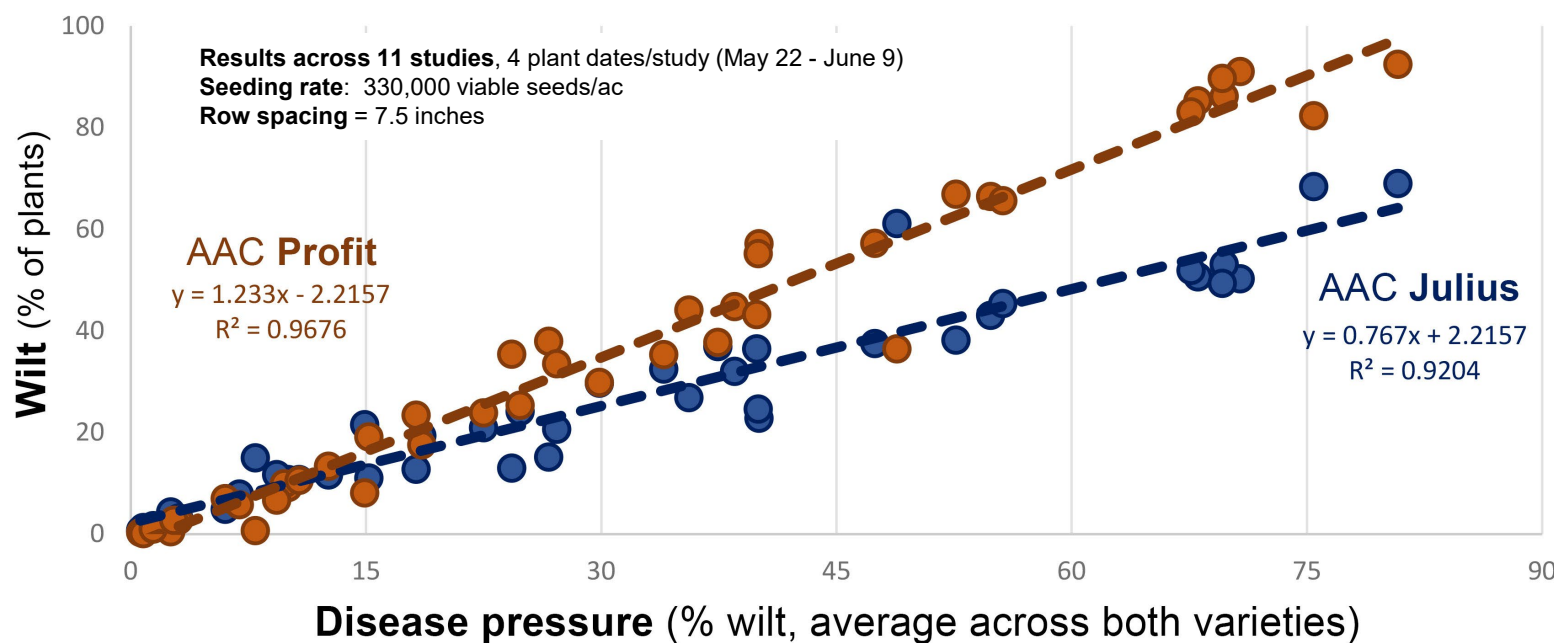
Visual estimate of the percent of the plants exhibiting wilt symptoms.

Plant date #1: 16-45% pods fully filled

Plant date #2: 16-71% pods fully filled

Plant date #3: 32-75% pods fully filled

Plant date #4: 28-91% pods fully filled

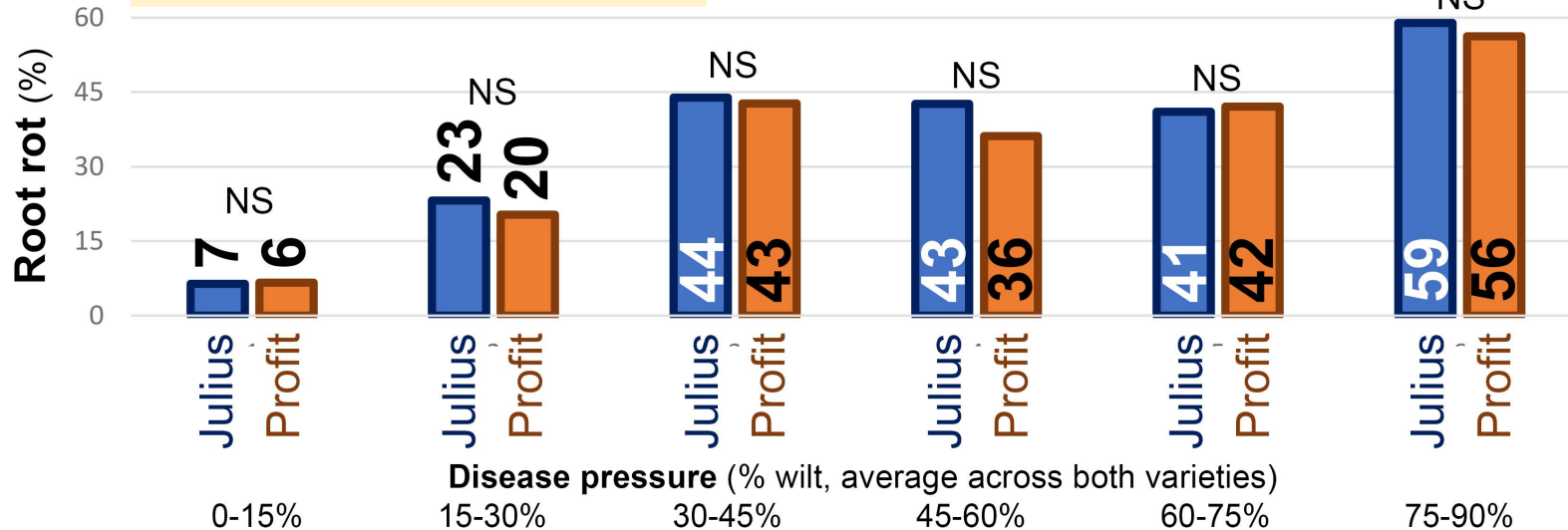




# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

## Carrington, ND (2023)

NS = not significantly different \* significantly different,  $P < 0.05$   
 \*\* significantly different,  $P < 0.01$  \*\*\* significantly different,  $P < 0.001$



**Results across 11 studies**, 4 plant dates/study (May 22 - June 9)

**Seeding rate:** 330,000 viable seeds/ac

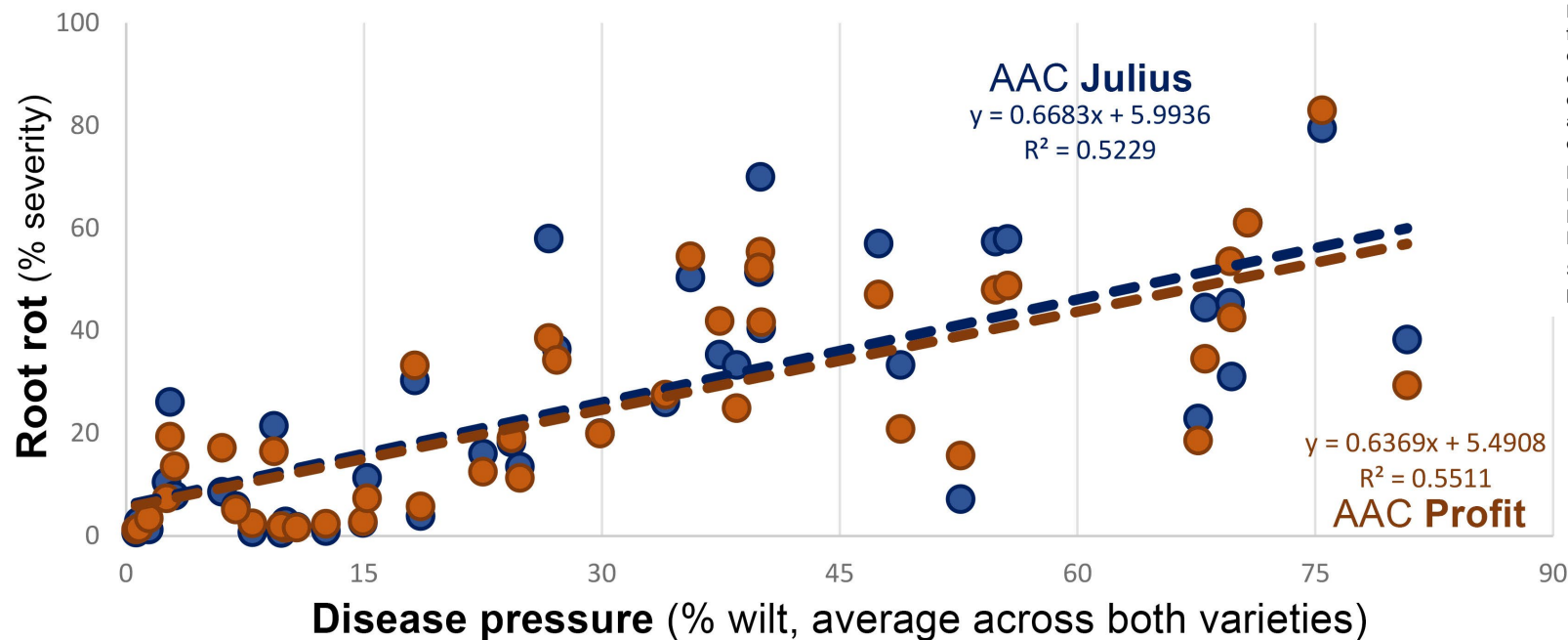
**Row spacing** = 7.5 inches

Root rot was assessed at early/mid vegetative growth.

Percent of the epicotyl plus first 2.5 cm of the tap root exhibiting yellow-brown cortical decay characteristic of Aphanomyces root rot and necrosis characteristic of Fusarium root rot

Plant date #1: 4-8 nodes  
 Plant date #2: 4-8 nodes  
 Plant date #3: 4-9 nodes  
 Plant date #4: 5-11 nodes

Sample size = 36 plants per plot x 6 replicates



# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Carrington, ND (2023)

Results across 11 studies, 4 plant dates/study (May 22 - June 9)  
Seeding rate: 330,000 viable seeds/ac Row spacing = 7.5 inches

Field: Field Q9F	Field Q9G	Field Q9A	Field 1	Field Q9B	F18 south	Field Q9D	Q9E east	Q9E west	F18 north	F18 north		COMBINED ANALYSIS
Last year seeded to peas: 2016	2013	2019	2020	2015	2015	2020	2015	2018	2020	2019		
Years out of peas: 12	9	3	2	7	7	2	7	4	2	3		
<b>Aphanomyces euteiches</b> (thousand DNA copies/gram of root)												
AAC Julius, non-treated	0	0	319	154627	47830	25260	38558	10616	17290	16818	10670	29272 a
AAC Profit, non-treated	0	0	47422	120633	37114	751	40581	110068	72670	10563	957	40069 a
<b>Fusarium oxysporum</b> (thousand DNA copies/gram of root)												
AAC Julius, non-treated	1.6	4.8	5.0	0	0	0	0	0	0	1.9	0	1.2 b
AAC Profit, non-treated	0	0	0	0	0	0	0	0	0	0	0	0 a
<b>PLANT POPULATION</b> (plants/ac; early vegetative growth)												
AAC Julius, non-treated	329459 a	328551 a	351311 a	336356								327039 ab
AAC Julius, Obvius	337227 a	333452 a	357265 a	343834								334608 a
AAC Profit, non-treated	336864 a	319730 a	354070 a	343688								324606 b
AAC Profit, Obvius	315592 a	327680 a	333887 a	350222								322121 b
CV:	11.7	12.5	8.9	11.6								2.3
<b>ROOT ROT SEVERITY</b> (%; early/mid vegetative growth)												
AAC Julius, non-treated	4 ab	14 a	6 a	16								27 b
AAC Julius, Obvius	2 ab	10 a	6 a	14								23 a
AAC Profit, non-treated	3 b	11 a	9 a	17								26 ab
AAC Profit, Obvius	1 a	10 a	7 a	13								23 a
CV:	91.6	25.1	34	24.6								9.2
<b>WILTED PLANTS</b> (%; mid/late pod-fill)												
AAC Julius, non-treated	5 b	6 ab	10 a	14								26 a
AAC Julius, Obvius	3 b	6 ab	12 a	21								32 ab
AAC Profit, non-treated	0 a	4 a	7 a	23								37 bc
AAC Profit, Obvius	1 a	6 b	10 a	31								44 c
CV:	43.7	19.4	27.8	18.2								21.7
<b>YIELD</b> (bushels/acre)												
AAC Julius, non-treated	76 a	66 ab	69 a	73								56 a
AAC Julius, Obvius	76 a	69 a	68 a	68								52 a
AAC Profit, non-treated	73 a	63 bc	58 b	59								43 b
AAC Profit, Obvius	72 a	59 c	57 b	51								37 c
CV:	7.8	8.7	10.1	13.3	15.1	15	16.9	20	27.9	47.6	26.2	8.2

COMBINED ANALYSIS

**Aphanomyces euteiches**  
(thousand DNA copies/gram of root)

AAC Julius, non-treated 29272 a

AAC Profit, non-treated 40069 a

COMBINED ANALYSIS

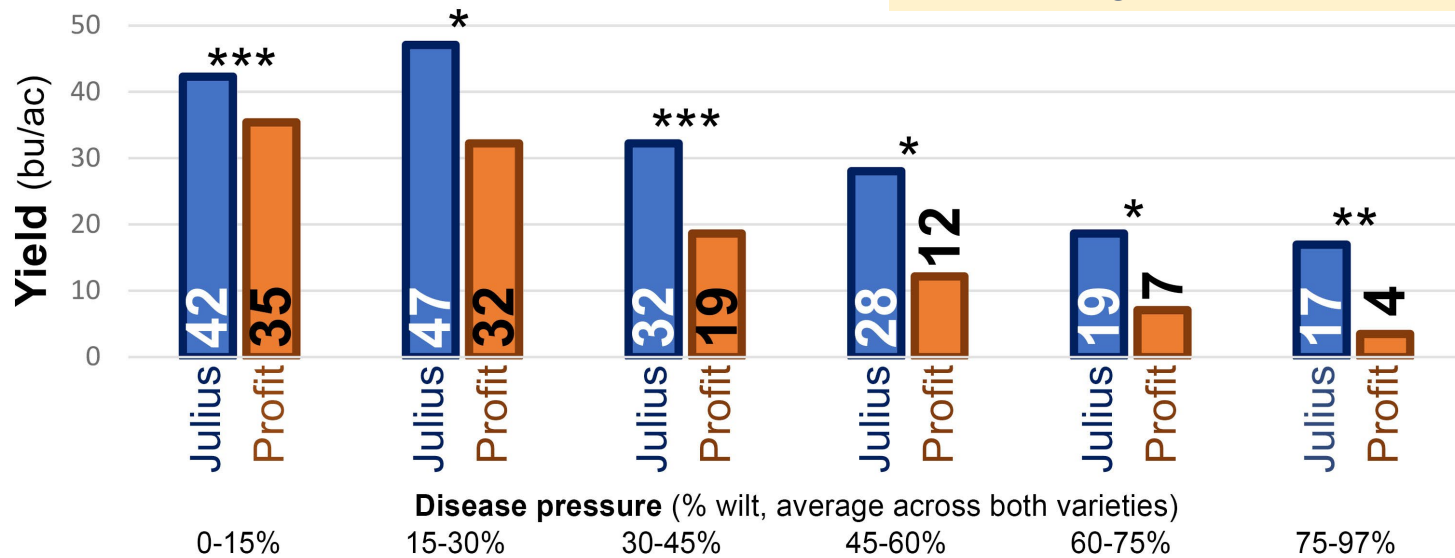
**Fusarium oxysporum**  
(thousand DNA copies/gram of root)

AAC Julius, non-treated 1.2 b

AAC Profit, non-treated 0 a

# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Carrington, ND (2024)



Results across 11 studies, 4 plant dates/study (April 23 - June 13)

Seeding rate: 330,000 viable seeds/ac

Row spacing = 7.5 inches

NS = not significantly different  
\* significantly different,  $P < 0.05$   
\*\* significantly different,  $P < 0.01$   
\*\*\* significantly different,  $P < 0.001$

Wilt was assessed at mid to late pod-fill.

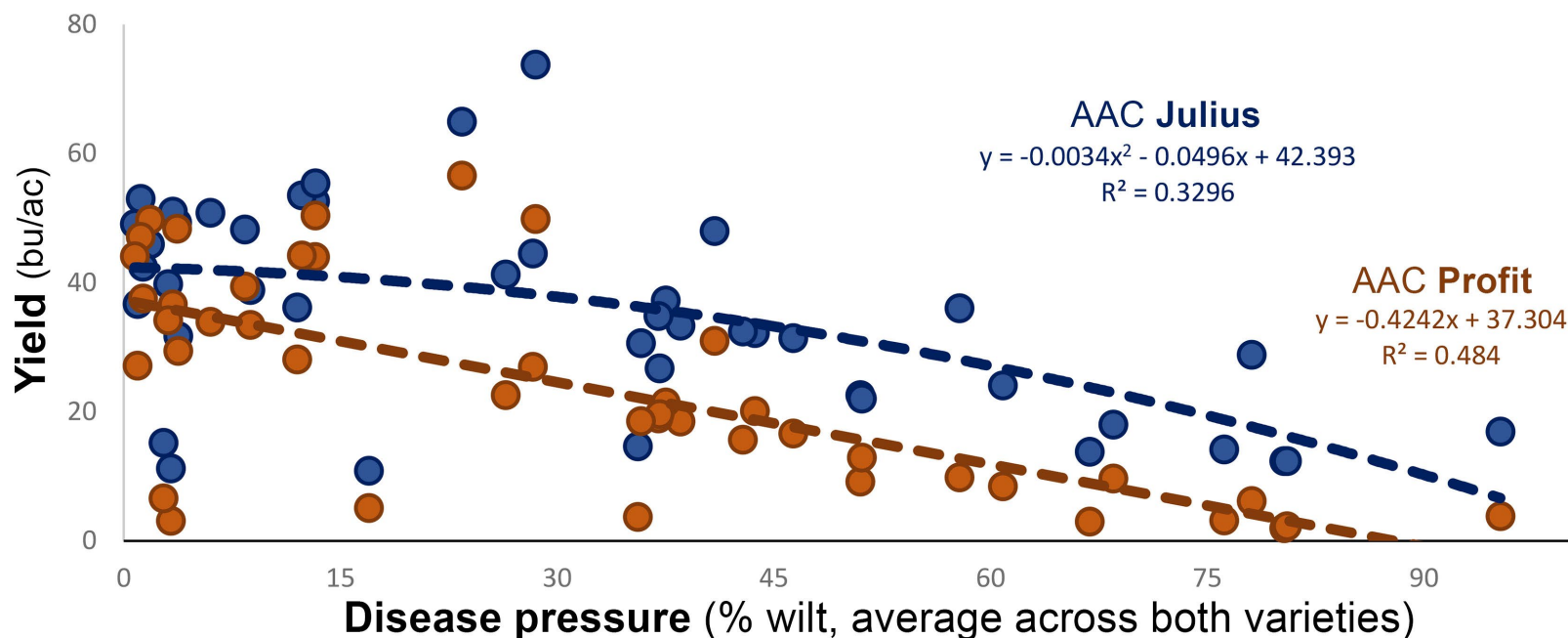
Visual estimate of the percent of the plants exhibiting wilt symptoms.

Plant date #1: 55-100% pods fully filled

Plant date #2: 30-100% pods fully filled

Plant date #3: 30-100% pods fully filled

Plant date #4: 10-100% pods fully filled



# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Carrington, ND  
(2024)

Results across 11 studies, 4 plant dates/study (April 23 - June 13)

Seeding rate: 330,000 viable seeds/ac

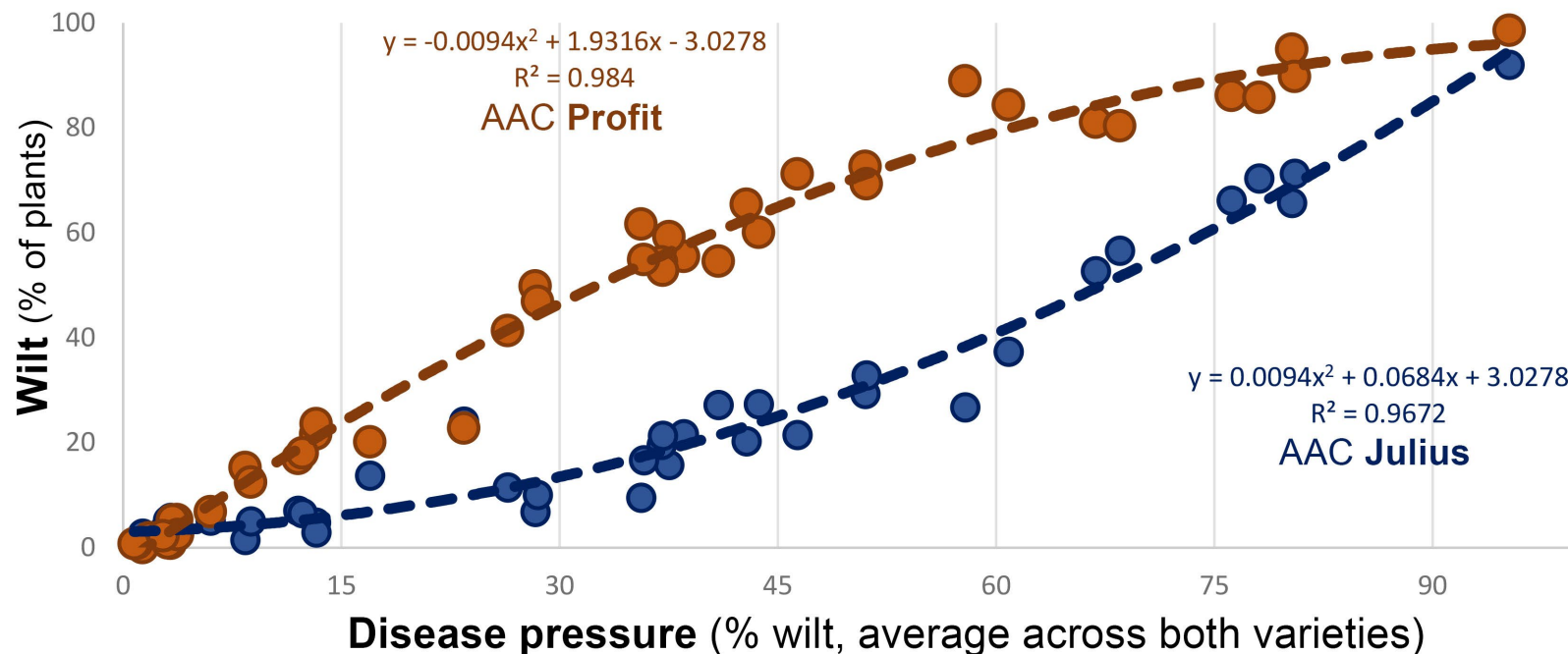
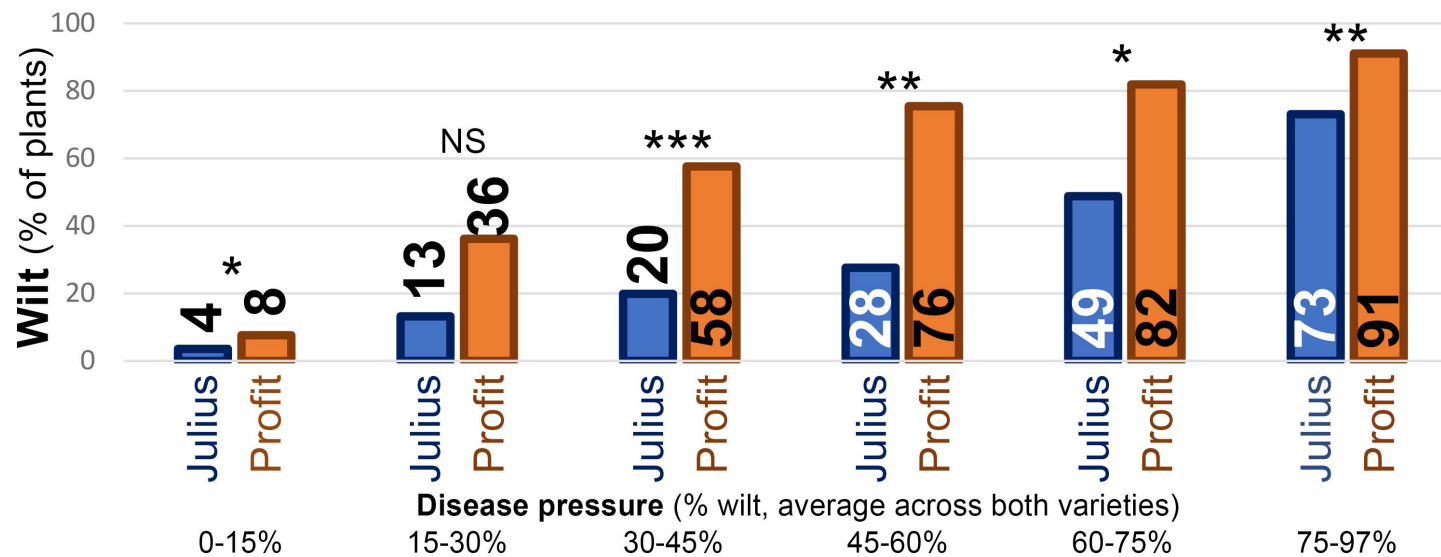
Row spacing = 7.5 inches

NS = not significantly different

\* significantly different,  $P < 0.05$

\*\* significantly different,  $P < 0.01$

\*\*\* significantly different,  $P < 0.001$



Wilt was assessed at mid to late pod-fill.

Visual estimate of the percent of the plants exhibiting wilt symptoms.

Plant date #1: 55-100% pods fully filled

Plant date #2: 30-100% pods fully filled

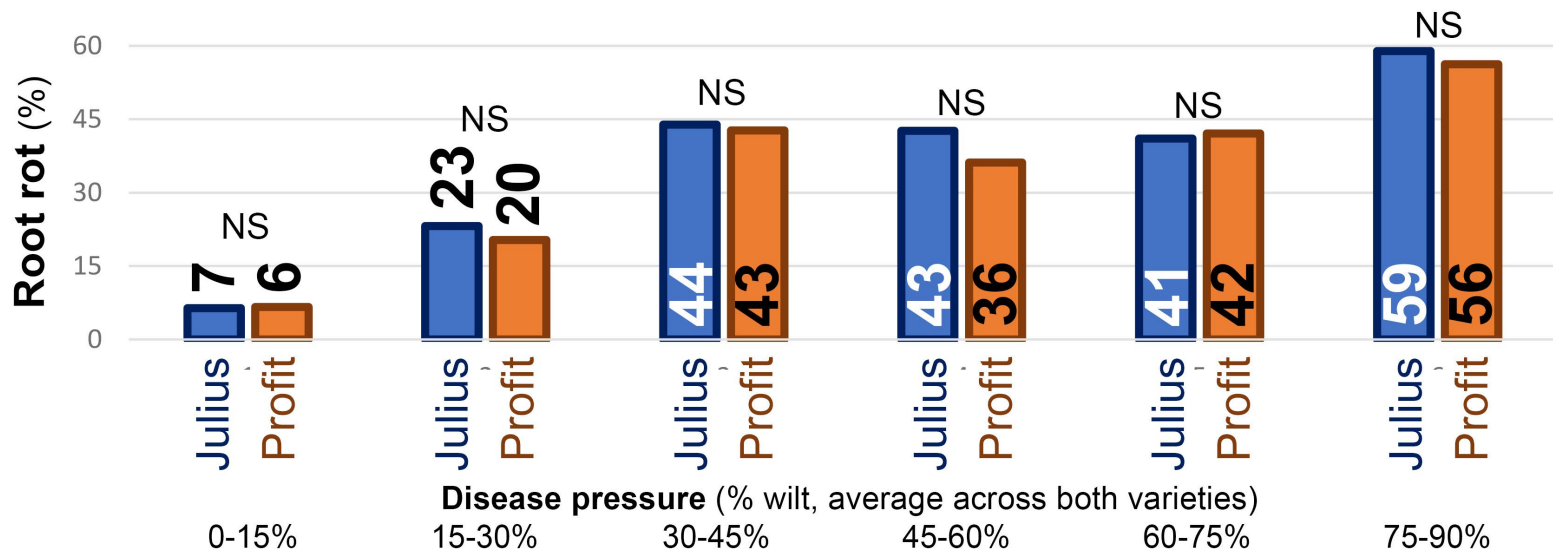
Plant date #3: 30-100% pods fully filled

Plant date #4: 10-100% pods fully filled



# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Carrington, ND (2024)



**Results across 11 studies**, 4 plant dates/study (April 23 - June 13)  
**Seeding rate:** 330,000 viable seeds/ac  
**Row spacing** = 7.5 inches

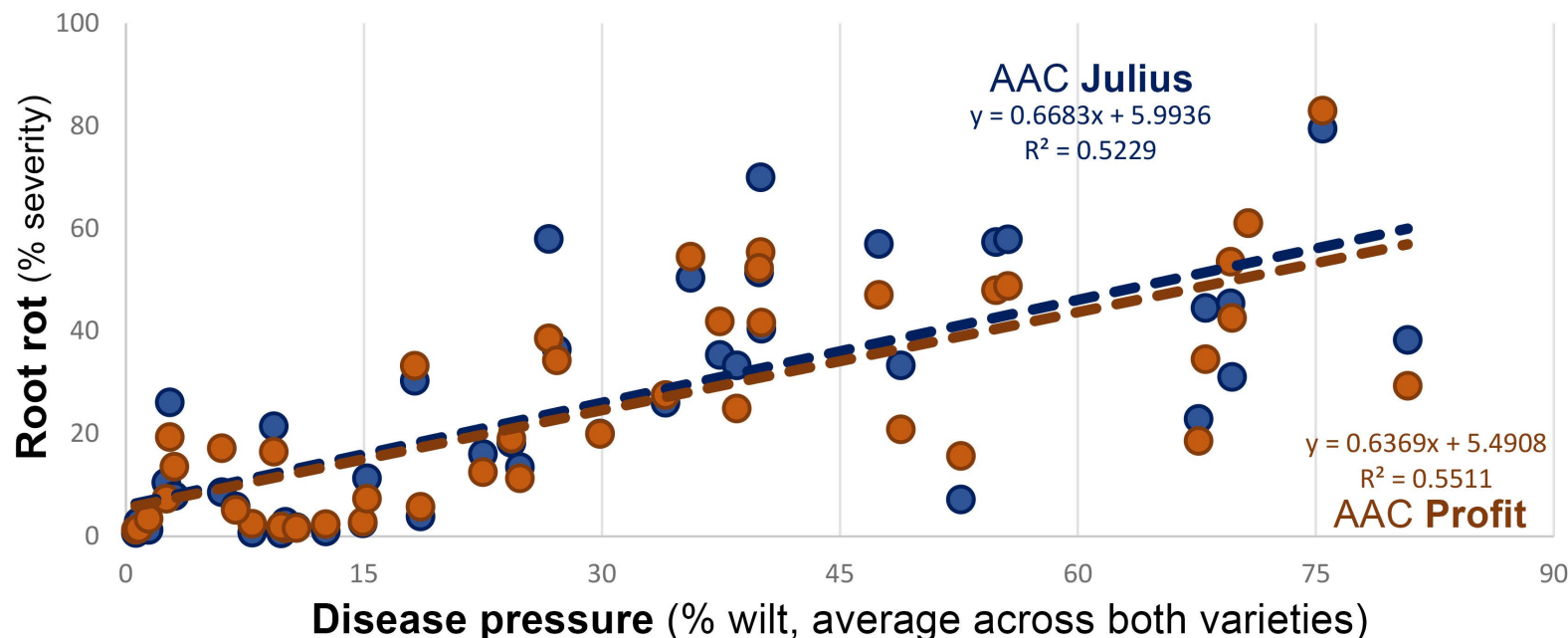
NS = not significantly different  
\* significantly different,  $P < 0.05$   
\*\* significantly different,  $P < 0.01$   
\*\*\* significantly diff.,  $P < 0.001$

Root rot was assessed at early/mid vegetative growth.

Percent of the epicotyl plus first 2.5 cm of the tap root exhibiting yellow-brown cortical decay characteristic of Aphanomyces root rot and necrosis characteristic of Fusarium root rot

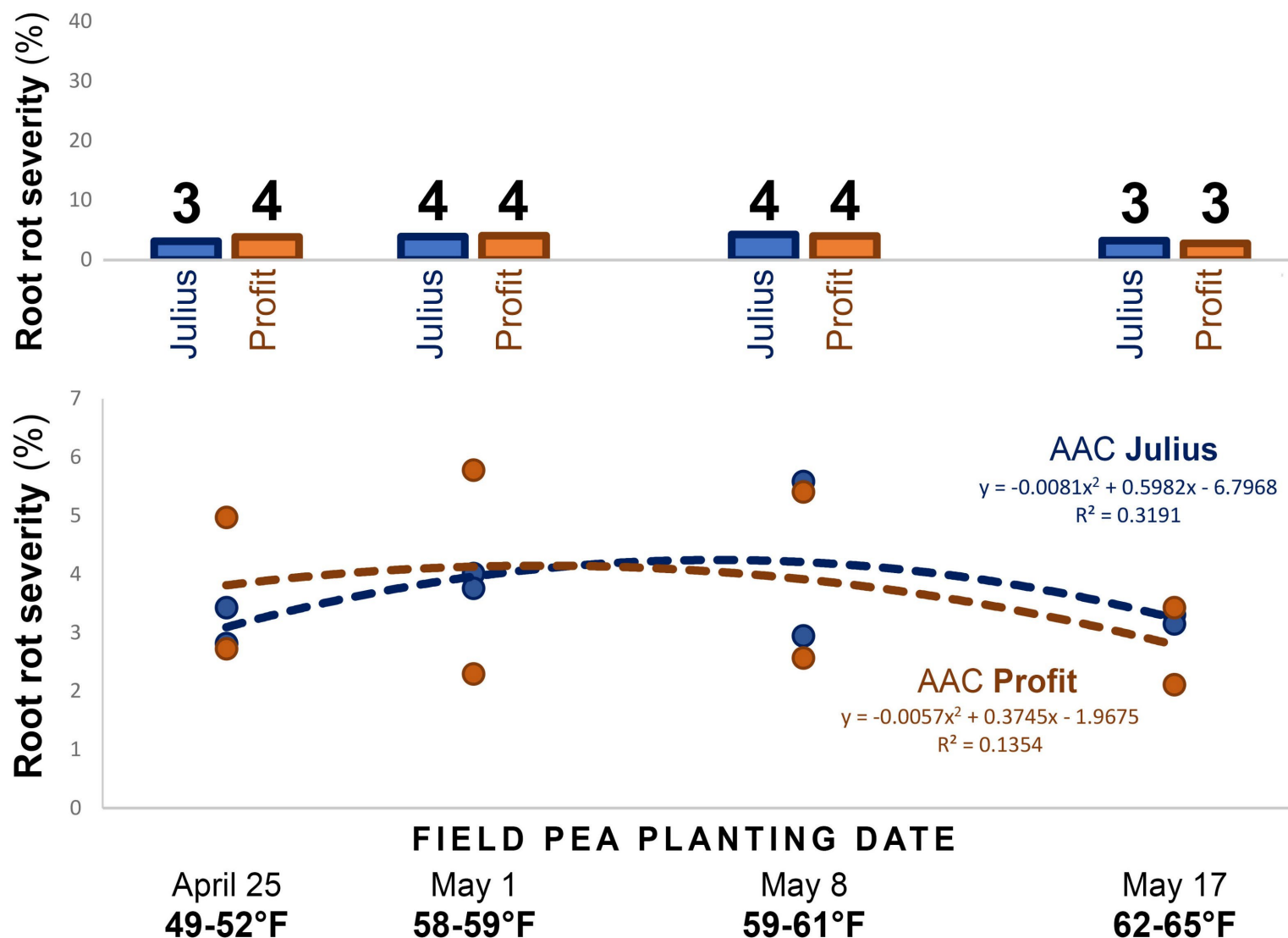
Plant date #1: 4-6 nodes  
Plant date #2: 4-8 nodes  
Plant date #3: 5-11 nodes  
Plant date #4: not assessed

Sample size = 36 plants per plot x 6 replicates (plant dates #1, #2); 16 plants x 6 replicates (plant date #3)



# Fusarium and Aphanomyces root rot of field peas: **Impact of variety selection**

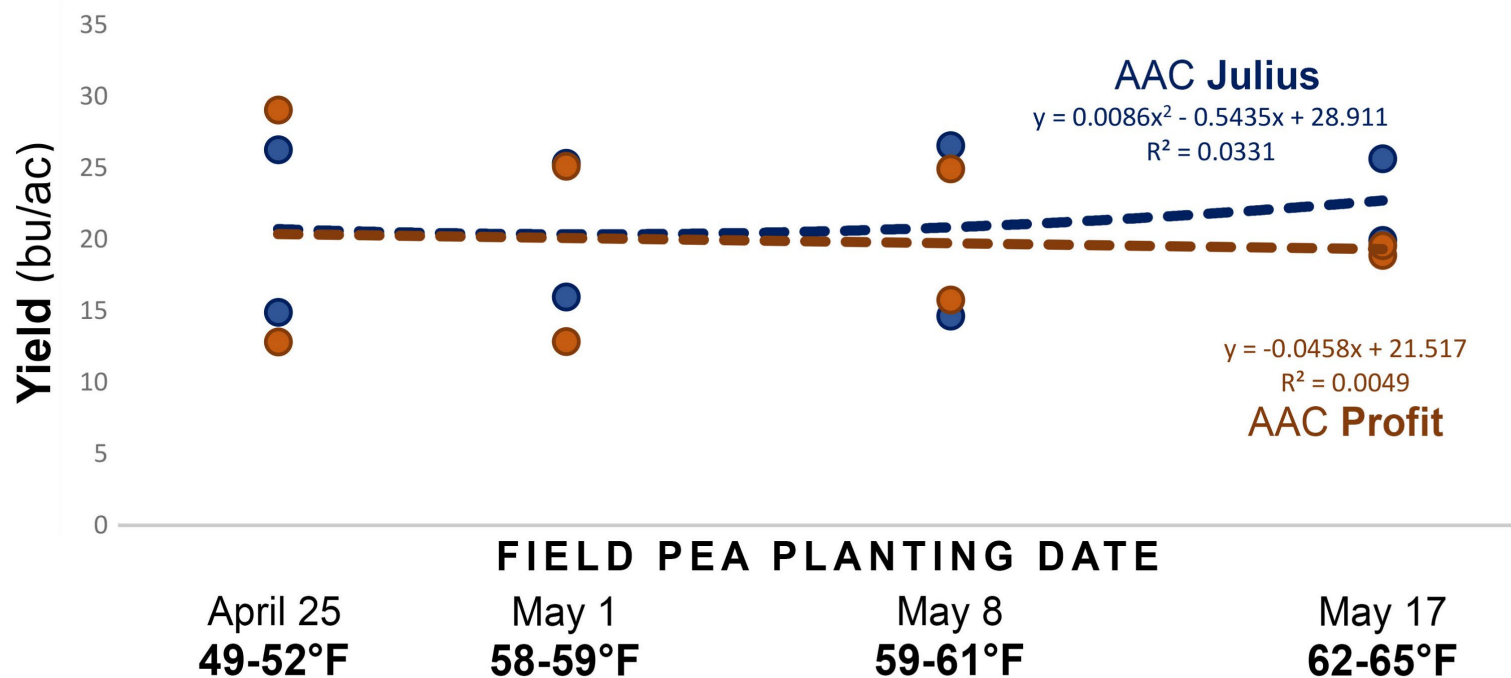
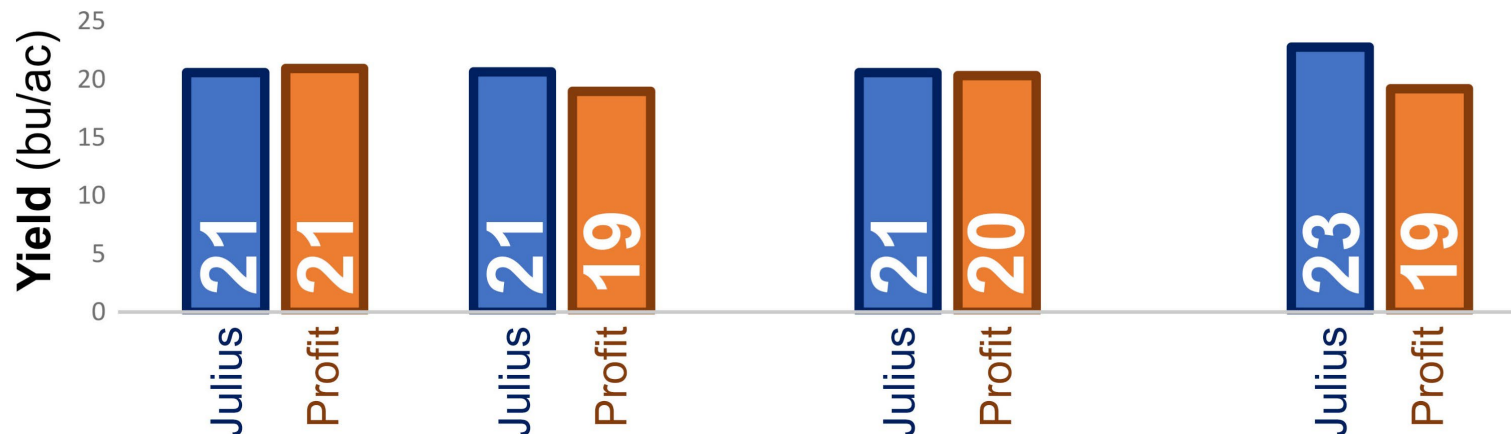
Williston, ND (2023): studies conducted under very low root rot pressure



Soil temperature (average, day and night) at 2-inch seeding depth, first 7 days after planting.

# Fusarium and Aphanomyces root rot of field peas: Impact of variety selection

Williston, ND (2023): studies conducted under very low root rot pressure



**Results across 3 studies, 4 plant dates/study (April 25 – May 17)**  
**Seeding rate:** 330,000 viable seeds/ac  
**Row spacing** = 7.0 inches

NS = not significantly different  
\* significantly different,  $P < 0.05$   
\*\* significantly different,  $P < 0.01$   
\*\*\* significantly diff.,  $P < 0.001$

**Root rot severity was very low across all planting dates and both varieties:** average 3-4% at early/mid vegetative growth in all planting dates and both varieties (see previous slide).

Percent of the epicotyl plus first 2.5 cm of the tap root exhibiting yellow-brown cortical decay characteristic of Aphanomyces root rot and necrosis characteristic of Fusarium root rot

Plant date #1: 5-7 nodes  
Plant date #2: 5-8 nodes  
Plant date #3: 5-8 nodes  
Plant date #4: 5-8 nodes

Sample size = 50 plants per plot x 6 replicates

Soil temperature (average, day and night) at 2-inch seeding depth, first 7 days after planting.

# Conclusions:

**The results suggest that there may be strong differences in tolerance to *Aphanomyces* and *Fusarium* root rot across field pea varieties.**

**The results also suggest that it may be possible to achieve excellent management of *Aphanomyces* and *Fusarium* root rot in field peas through the integrated use of tolerant varieties, planting date and fungicide seed treatment.**

**These results need to be confirmed at on-farm sites.**

The strains of *Aphanomyces euteiches*, the *Fusarium* species, and the relative importance of *Aphanomyces* versus *Fusarium* can differ across fields.

In 2025, field testing will be expanded to on-farm sites in western North Dakota.





## Integrated management of **Aphanomyces and Fusarium root rot** in field peas: (1) Impact of variety selection

**Michael Wunsch**, Suanne Kallis, Jesse Hafner, Aaron Fauss NDSU Carrington Res. Ext. Center  
in collaboration with Edson Ncube and Audrey Kalil, NDSU Williston Research Extension Center

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