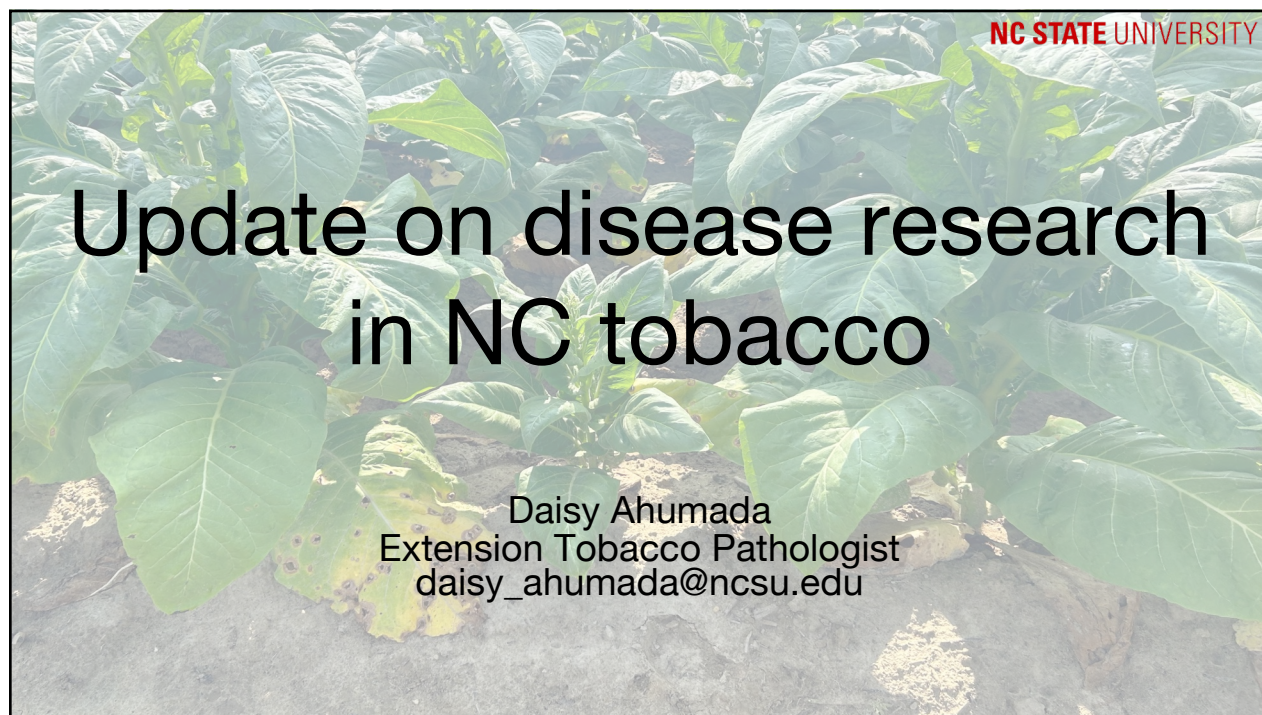




Update on disease research in NC tobacco

Daisy Ahumada
Extension Tobacco Pathologist
daisy_ahumada@ncsu.edu

1



Black shank Disease Ratings

2



Flue-Cured Tobacco Variety Disease Ratings

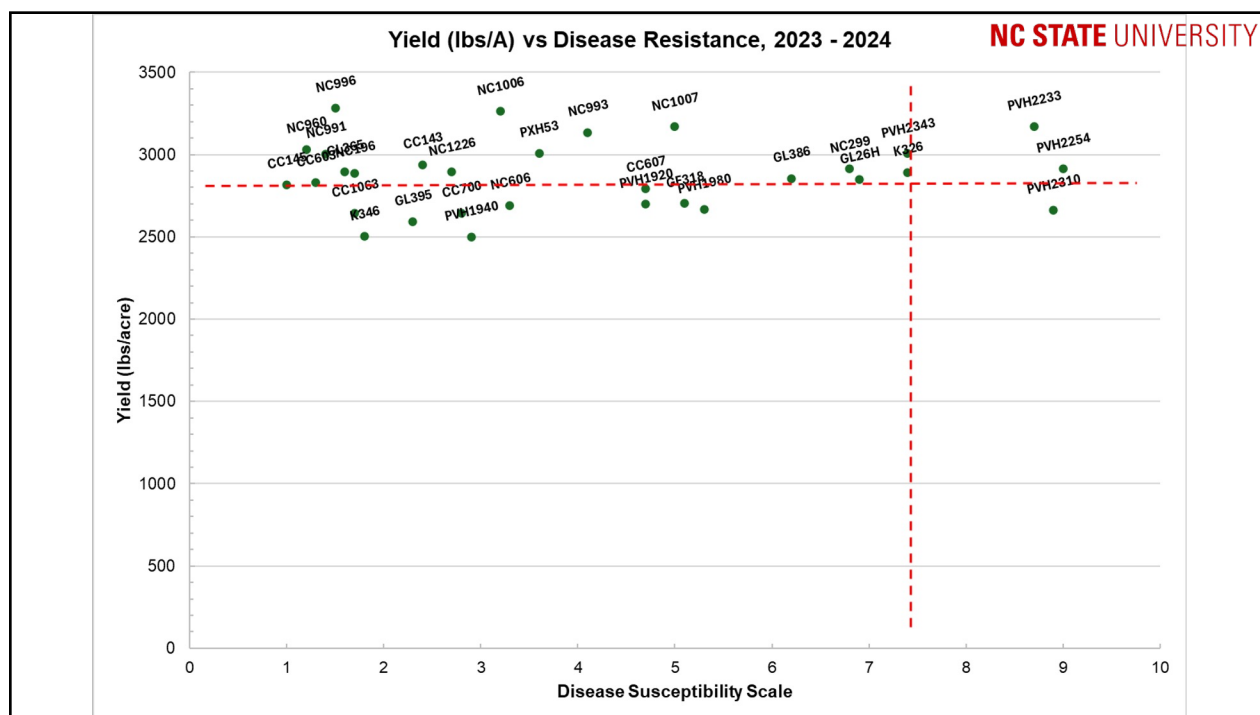


Daisy Ahumada & William Hardee

Table 1. Susceptibility scales for flue-cured tobacco varieties to black shank and bacterial wilt, 2022 - 2024

Variety	Black shank ^a				Bacterial wilt ^a			
	<i>Ph</i> ^b gene	<i>Wz</i> ^c gene	Susceptibility ^d scale values	Designation ^e	Survival (%) ^f	Susceptibility ^d scale values	Designation ^e	Survival (%) ^f
CC1063	-	-	1.7	Resistant	84	2.7	Moderately resistant	73
CC143	-	-	2.4	Resistant	76	2.3	Resistant	69
CC145	-	-	1	Highly resistant	89	1.8	Resistant	77
CC603	+	-	1.3	Highly resistant	79	2.1	Resistant	78
CC607	+	-	4.7	Moderately susceptible	18	2.9	Moderately resistant	78
CC700	+	-	2.8	Moderately resistant	72	3.0	Moderately resistant	68
GF318	+	-	5.1	Moderately susceptible	52	3.1	Moderately resistant	69
GL26H	-	-	6.9	Susceptible	41	5.3	Moderately susceptible	46
GL365	-	-	1.6	Resistant	86	3.0	Moderately resistant	65

3



4



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Table A. Fungicides evaluated for black shank suppression in Johnston and Wilson County, NC, 2024

Treatment	Application 1*	Application 2	Application 3
1	Untreated	-	-
2	Orondis Gold DC (at transplant)	-	-
3	Orondis Gold DC (Pre plant)	-	-
4	Orondis Gold DC (surface applied band)	-	-
5	Orondis Gold Premix (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
6	Orondis Gold DC (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
7	Orondis Gold DC (at transplant)	Revus (16 fl oz/A)	Presidio (4 fl oz/A)
8	Ridomil (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
9	Revus (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
10	Orondis Gold DC (Pre plant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
11	Orondis Gold DC (surface applied band)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)

*Orondis Products applied at 28 fl oz/A

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Treatment	Application 1*	Application 2	Application 3
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2	Orondis Gold DC (at transplant)	Only one treatment	
3	Orondis Gold DC (Pre plant)		
4	Orondis Gold DC (surface applied band)		
5	Orondis Gold Premix (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
6	Orondis Gold DC (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
7	Orondis Gold DC (at transplant)	Revus (16 fl oz/A)	Presidio (4 fl oz/A)
8	Ridomil (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
9	Revus (at transplant)	Ridomil (8 fl oz/A)	Presidio (4 fl oz/A)
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9

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10

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11

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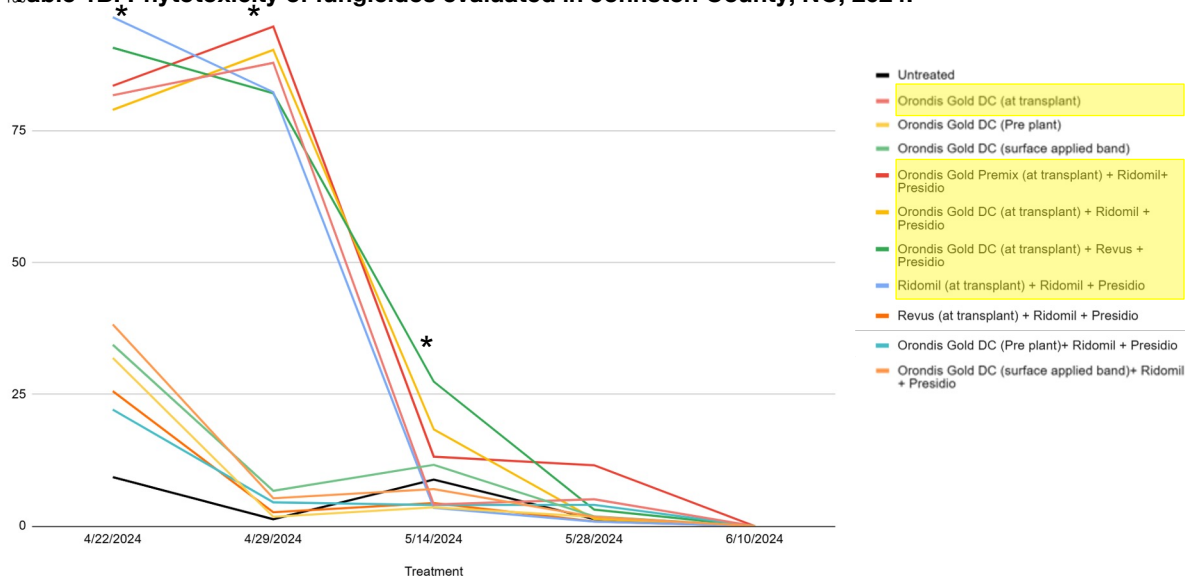
16

Table A. Fungicides evaluated for black shank suppression in Johnston and Wilson County, NC, 2024.

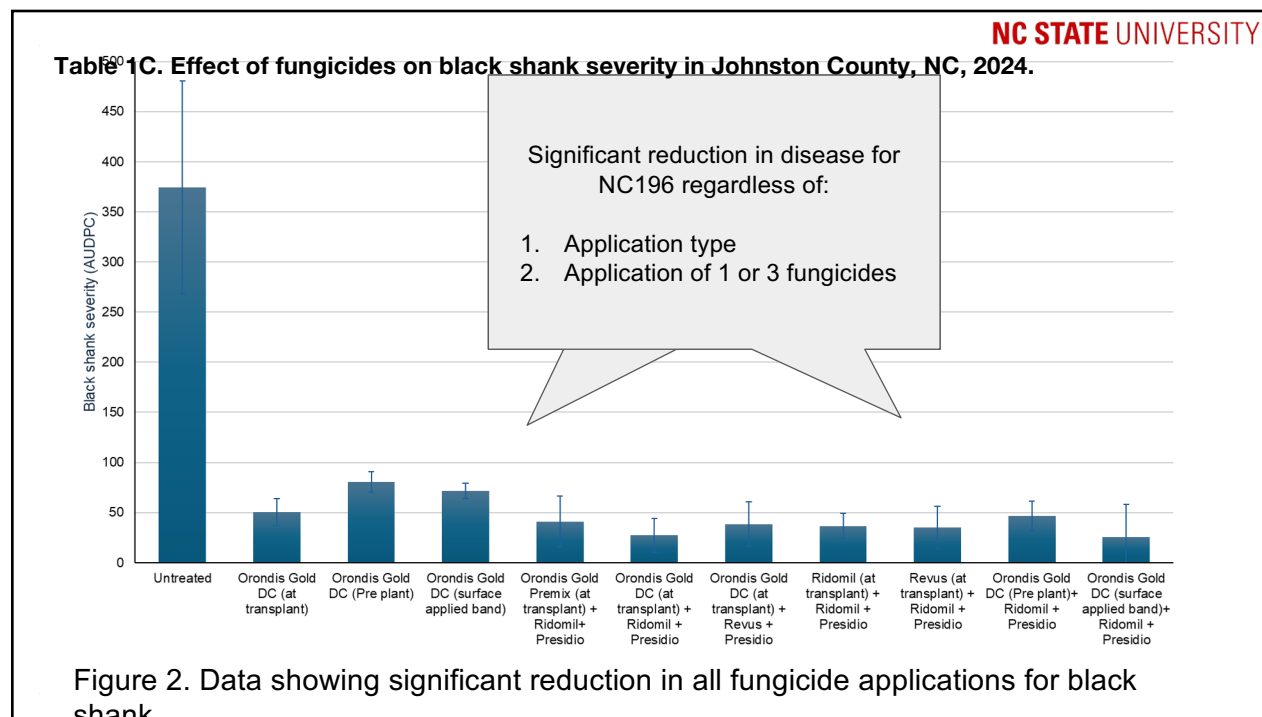
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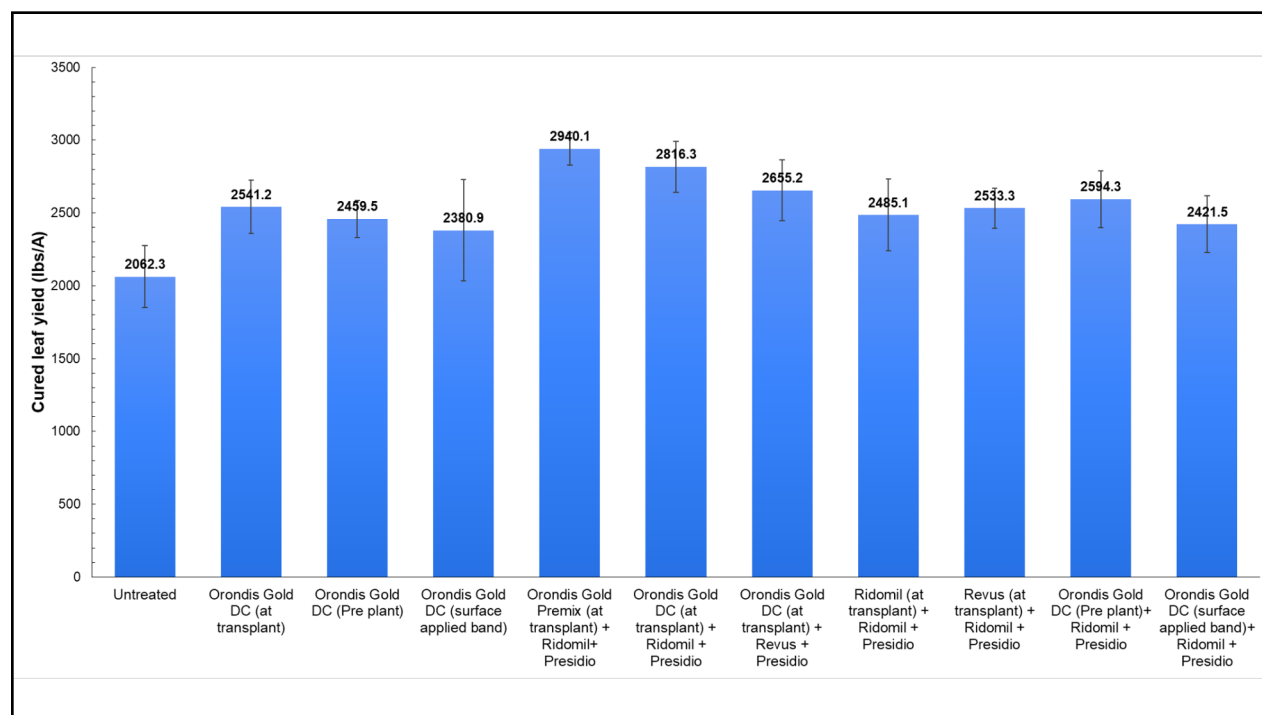
17

Table 1B. Phytotoxicity of fungicides evaluated in Johnston County, NC, 2024.**Figure 1. Data showing significant phytotoxicity in transplant applications for black shank**

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Table 1D. Effect of fungicides on yield in Johnston County, NC, 2024

Treatment	Cured Yield (lb/A)	Yield Difference (lbs/A)	Yield Difference (%)	Price (\$)/lb	Fungicide + application cost / A	ROI (\$)
Untreated	2062.3					
Orondis Gold DC (at transplant)	2541.2	478.9	23.2	1.97	139	805
Orondis Gold DC (Pre plant)	2459.5	397.2	19.3	1.97	139	644
Orondis Gold DC (surface applied band)	2380.9	318.6	15.5	1.97	139	489
Orondis Gold Premix (at transplant) + Ridomil+ Presidio	2940.1	877.8	42.6	1.97	349	1380
Orondis Gold DC (at transplant) + Ridomil + Presidio	2816.3	754.0	36.6	1.97	349	1136
Orondis Gold DC (at transplant) + Revus + Presidio	2655.2	592.9	28.7	1.97	386	782
Ridomil (at transplant) + Ridomil + Presidio	2485.1	422.9	20.5	1.97	313	521
Revus (at transplant) + Ridomil + Presidio	2533.3	471.1	22.8	1.97	350	578
Orondis Gold DC (Pre plant)+ Ridomil + Presidio	2594.3	532.0	25.8	1.97	349	699
Orondis Gold DC (surface applied band)+ Ridomil + Presidio	2421.5	359.2	17.4	1.97	349	359

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No chemical controls necessary

Rotate between using 1 fungicide a season 1 year to 2-3 fungicides a season the following year



Any variety

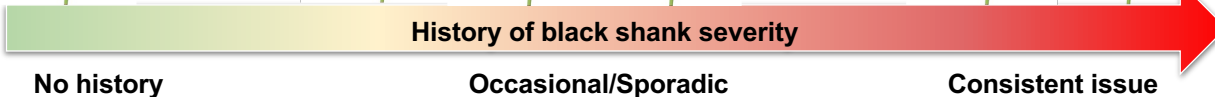
Moderately susceptible to resistant varieties, rotating different sources of resistance



Rotate between 2-3 fungicides a season each year



Moderately resistant to resistant varieties, rotating different sources of resistance



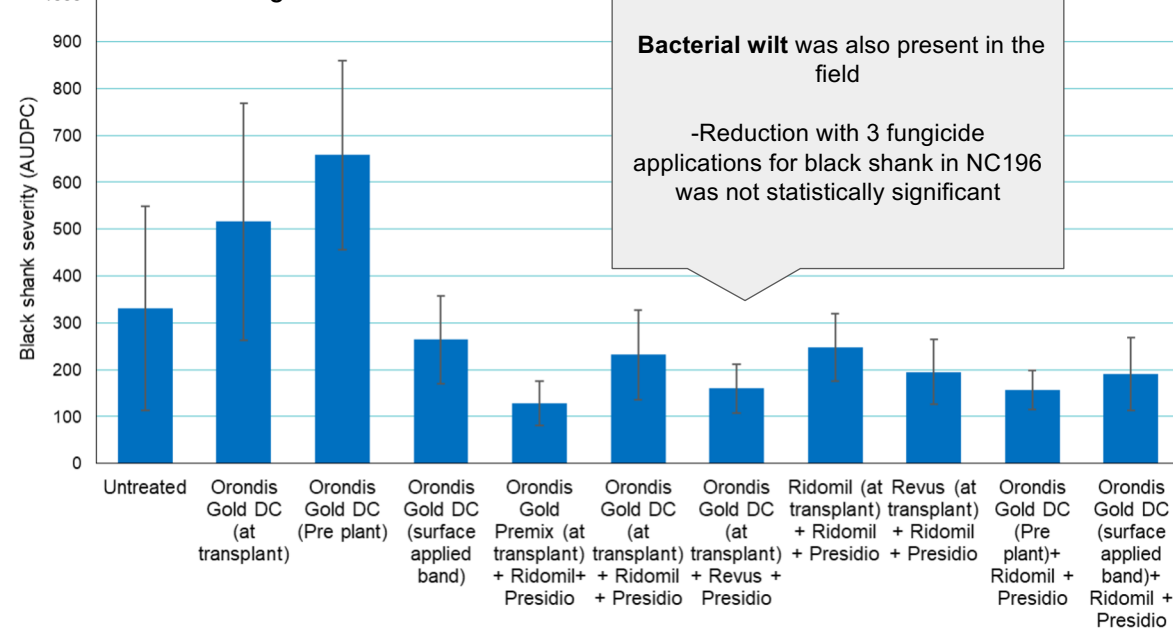
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Table A. Fungicides evaluated for black shank suppression in Johnston and Wilson County, NC, 2024

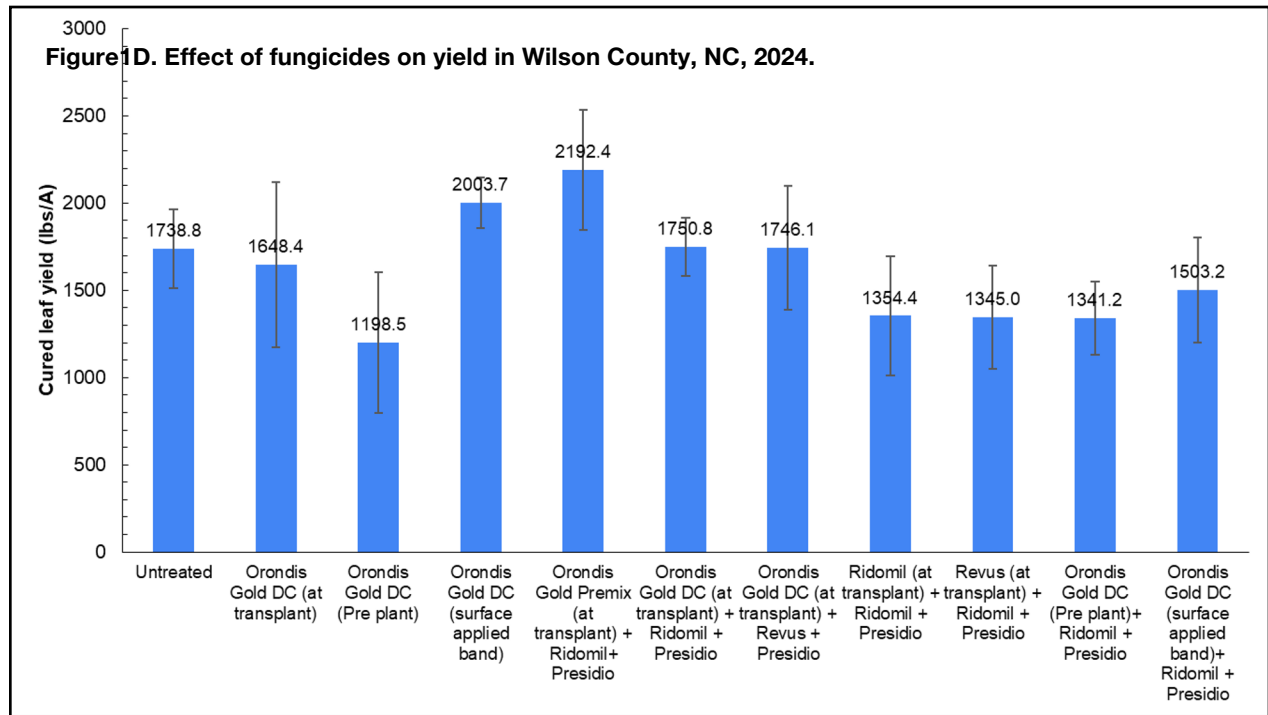
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*Orondis Products applied at 28 fl oz/A

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Table 2B. Effect of fungicides on black shank severity in Wilson County, NC, 2024

24



25

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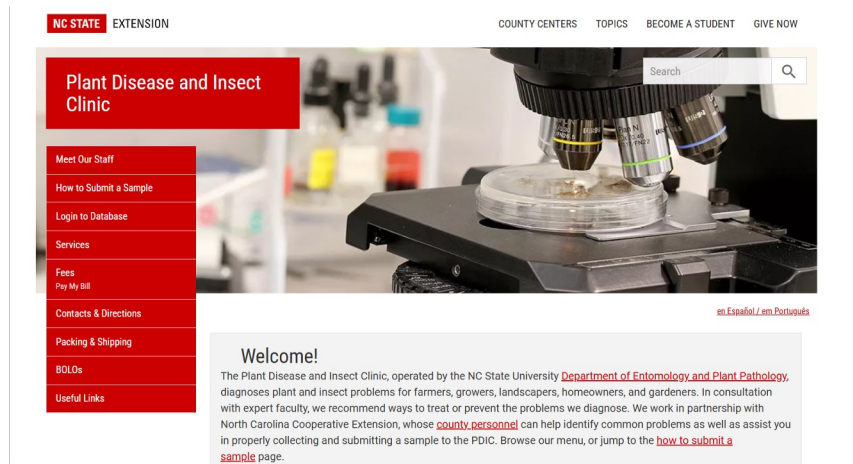
Table 1D. Effect of fungicides on yield in Wilson County, NC, 2024

Treatment	Cured Yield (lb/A)	Yield Difference (lbs/A)	Yield Difference (%)	Price (\$)/lb	Fungicide + application cost / A	ROI
Untreated	1738.8					
Orondis Gold DC (at transplant)	1648.4	-90.4	-5.2	1.97	139	-317
Orondis Gold DC (Pre plant)	1198.5	-540.3	-31.1	1.97	139	-1203
Orondis Gold DC (surface applied band)	2003.7	264.9	15.2	1.97	139	383
Orondis Gold Premix (at transplant) + Ridomil+ Presidio	2192.4	453.6	26.1	1.97	349	545
Orondis Gold DC (at transplant) + Ridomil + Presidio	1750.8	12.1	0.7	1.97	349	-325
Orondis Gold DC (at transplant) + Revus + Presidio	1746.1	7.3	0.4	1.97	386	-372
Ridomil (at transplant) + Ridomil + Presidio	1354.4	-384.4	-22.1	1.97	313	-1070
Revus (at transplant) + Ridomil + Presidio	1345.0	-393.8	-22.6	1.97	350	-1126
Orondis Gold DC (Pre plant)+ Ridomil + Presidio	1341.2	-397.5	-22.9	1.97	349	-1132
Orondis Gold DC (surface applied band)+ Ridomil + Presidio	1503.2	-235.5	-13.5	1.97	349	-813

26

Confirm the disease or diseases you are treating for:

1. Work with your local extension agent



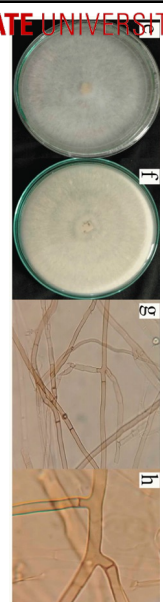
<https://pdic.ces.ncsu.edu/>

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Rhizoctonia damping-off (soreshin) & target spot *Rhizoctonia solani* species-complex AG2-2, AG3, and AG4

Thanatephorus cucumeris
-sexual form (teleomorph)

Domain: Eukarya
Kingdom: Fungi
Subkingdom: Dikarya
Phylum: Basidiomycota
Subphylum: Agaricomycotina
Class: Agaricomycetes
Order: Cantharellales
Family: Ceratobasidiaceae
Genus: *Rhizoctonia*



Naqvi et al. 2024

Gonzalez et al. 2010, Tredway and Burpee, 2001

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29



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Methyl bromide alternatives

Table 2. Recovery of *Rhizoctonia solani* from Styrofoam trays before and after disinfestation treatments

Treatment	Initial Level	Final Level	Percent Control
Inoculated control	9 ^x	9	0 a ^y
Dry heat 82°C/2 h	6	6	0 a
Dry heat 71°C/2 h	7	6	14.3 a
Dip in 0.5% NaOCl/10 min	9	5	44.5 b
Dip in 10% B-10/1 h	6	2	66.7 b
Steam 80°C/2 h	6	0	100 c
Steam 80°C/1 h	6	0	100 c
Steam 80°C/30 min.	6	0	100 c
Methyl bromide	7	0	100 c

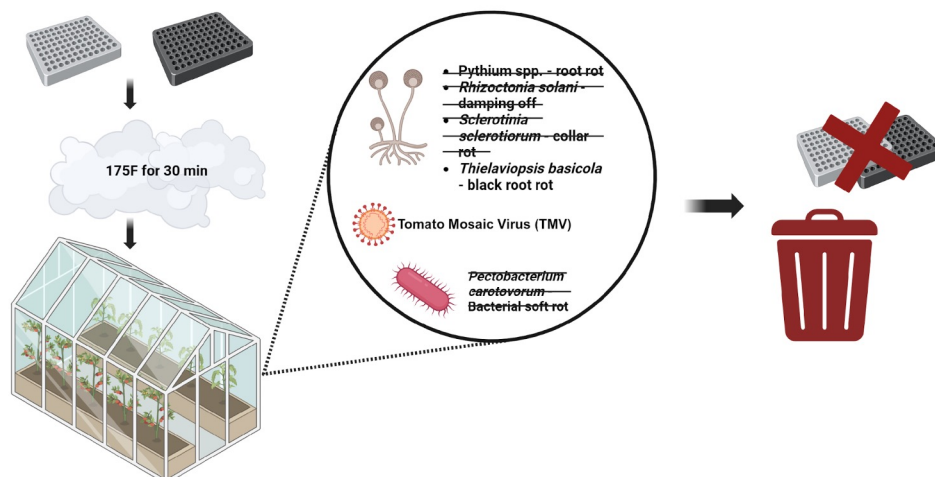
^x Average number of *Rhizoctonia solani* colonies per tray isolated on alkaline water agar plus antibiotics.

^y Numbers followed for the same letter are not significantly different according to the Waller-Duncan *k*-ratio *t* test (*P* = 0.05).

Gutierrez et al. 1997

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Steaming

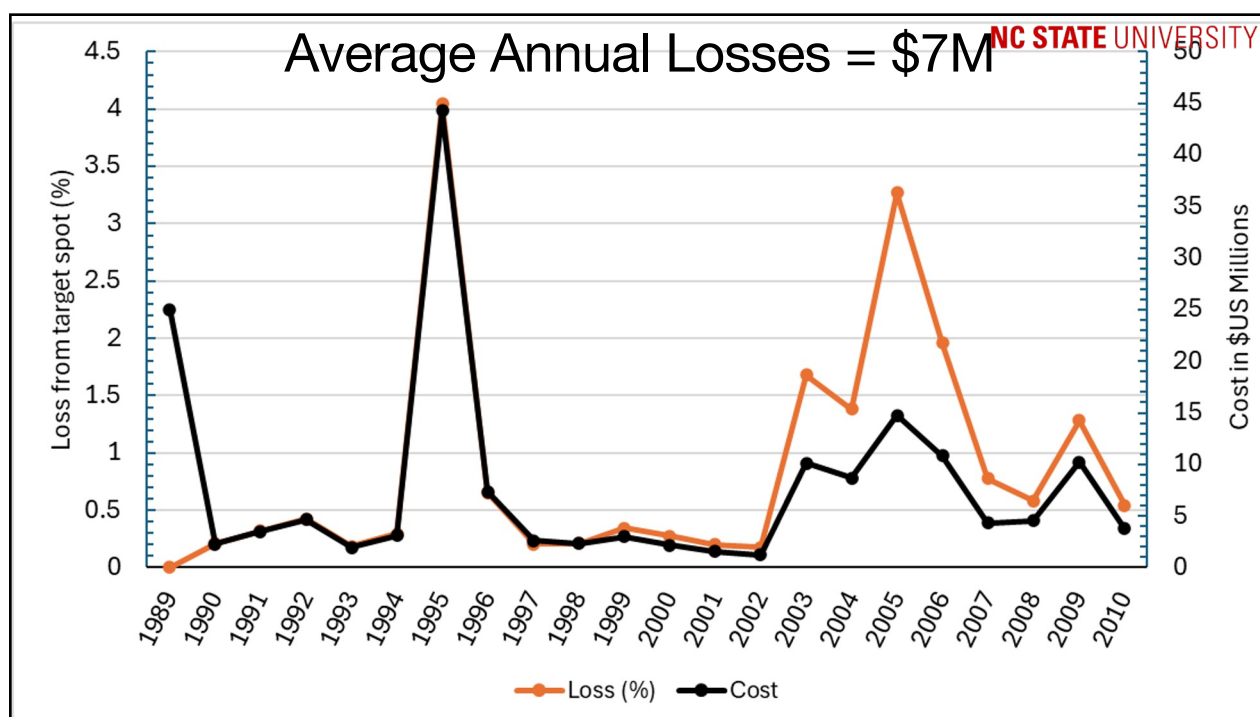


Gutierrez et al. 1997

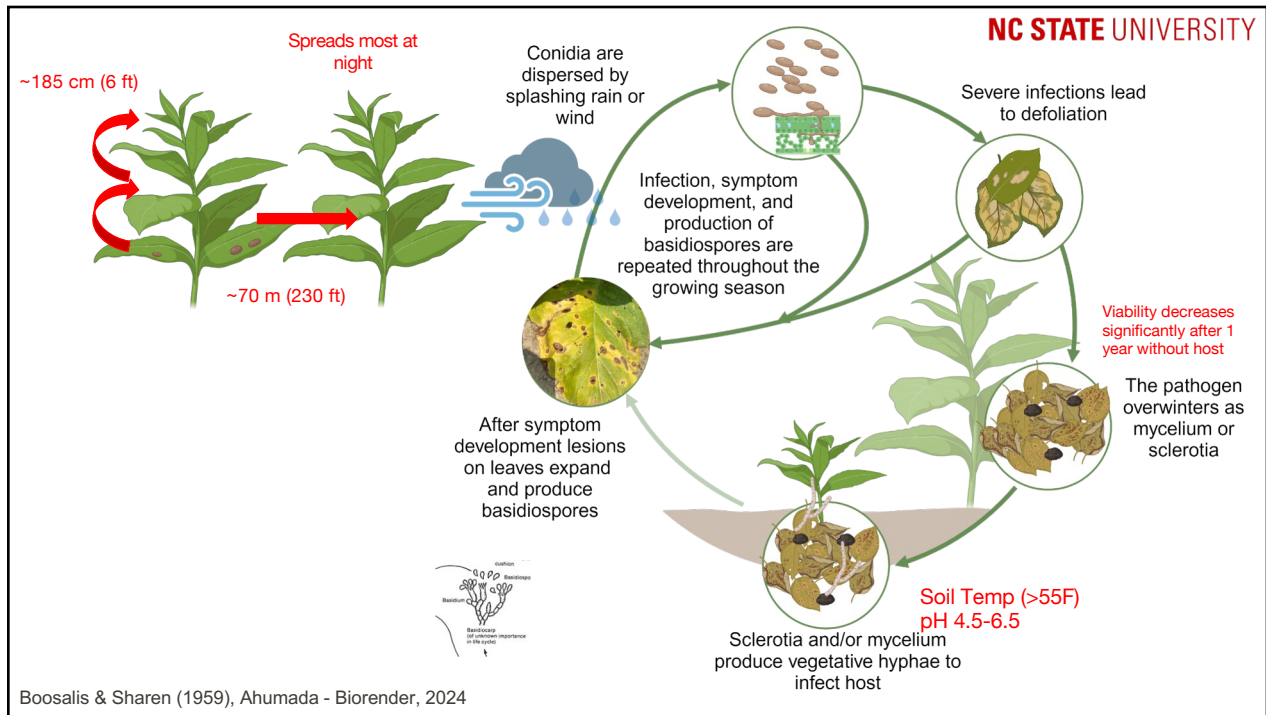
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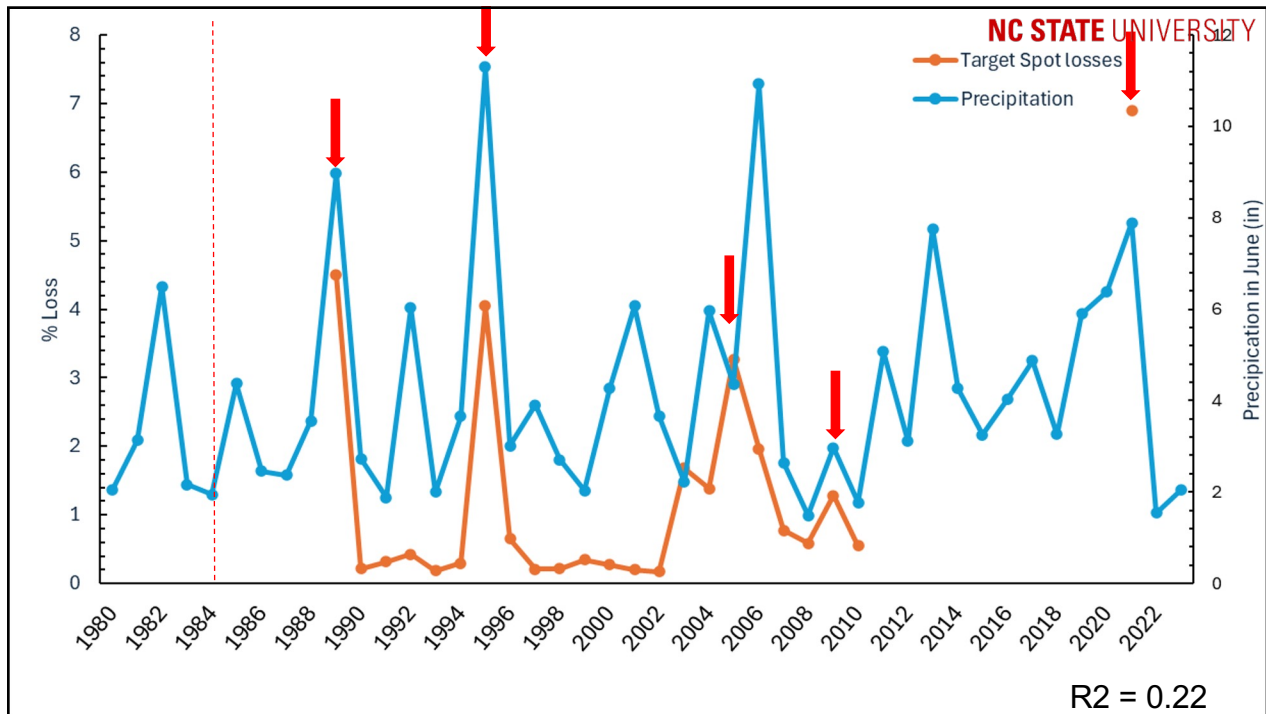
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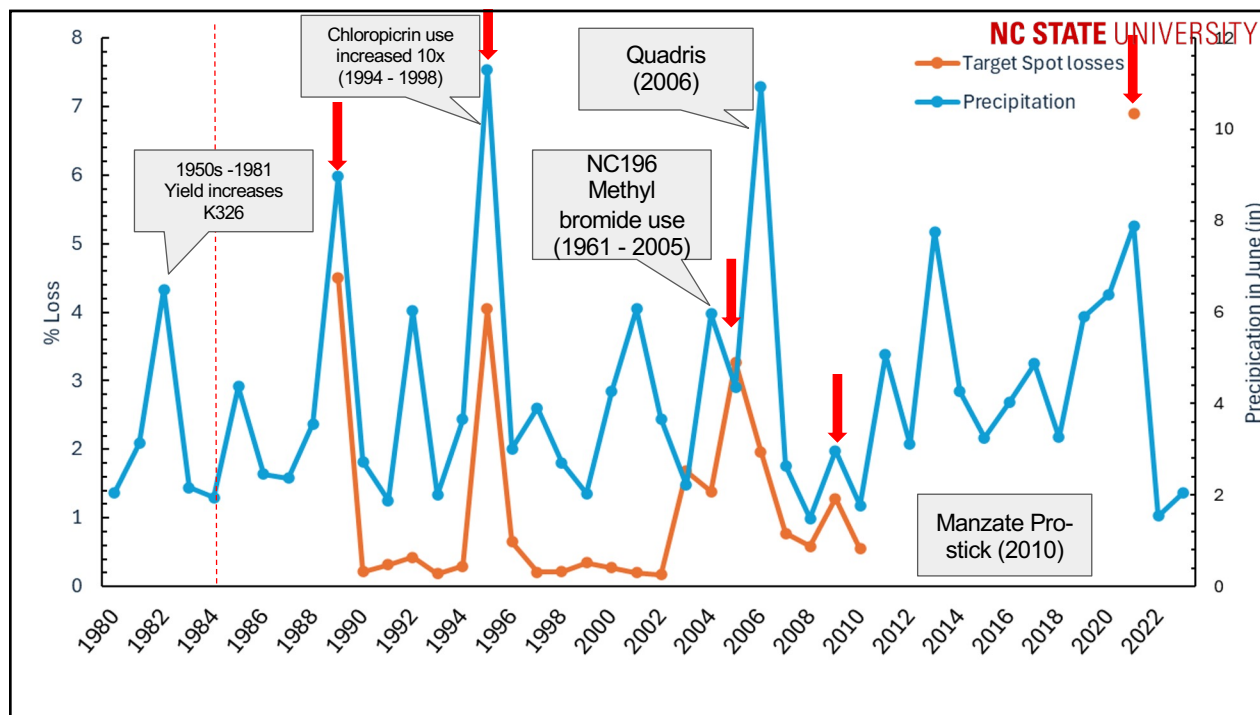
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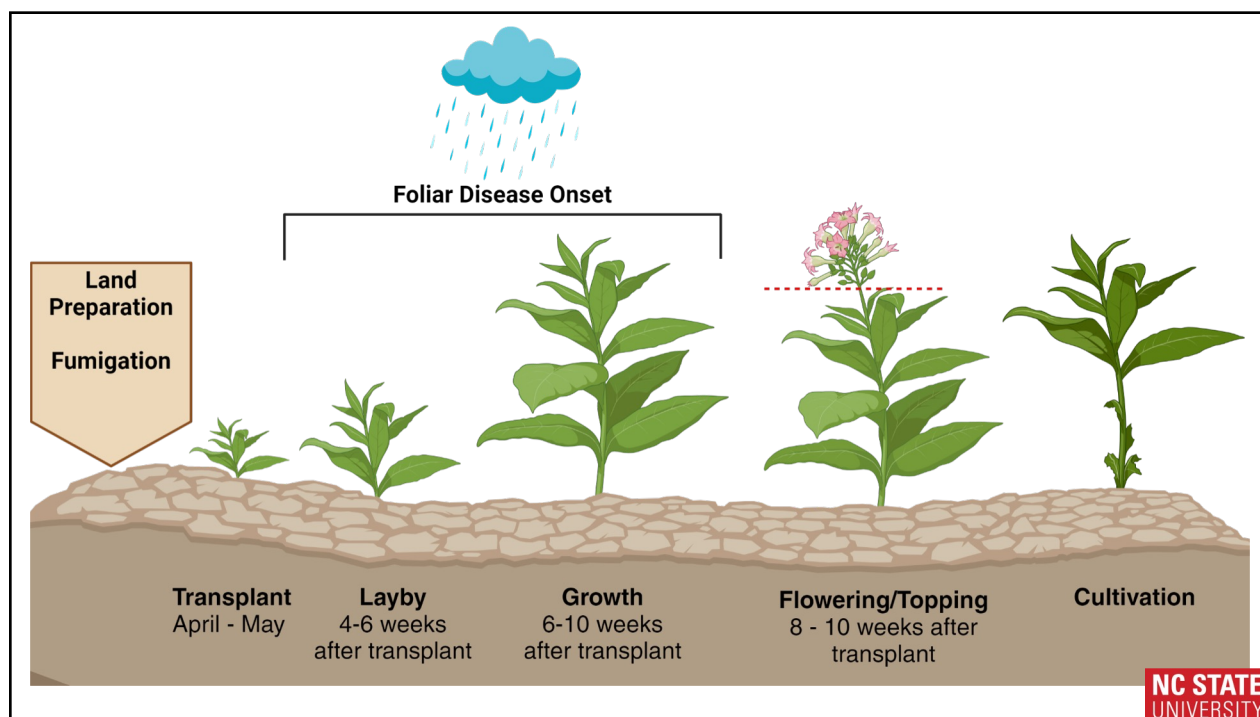
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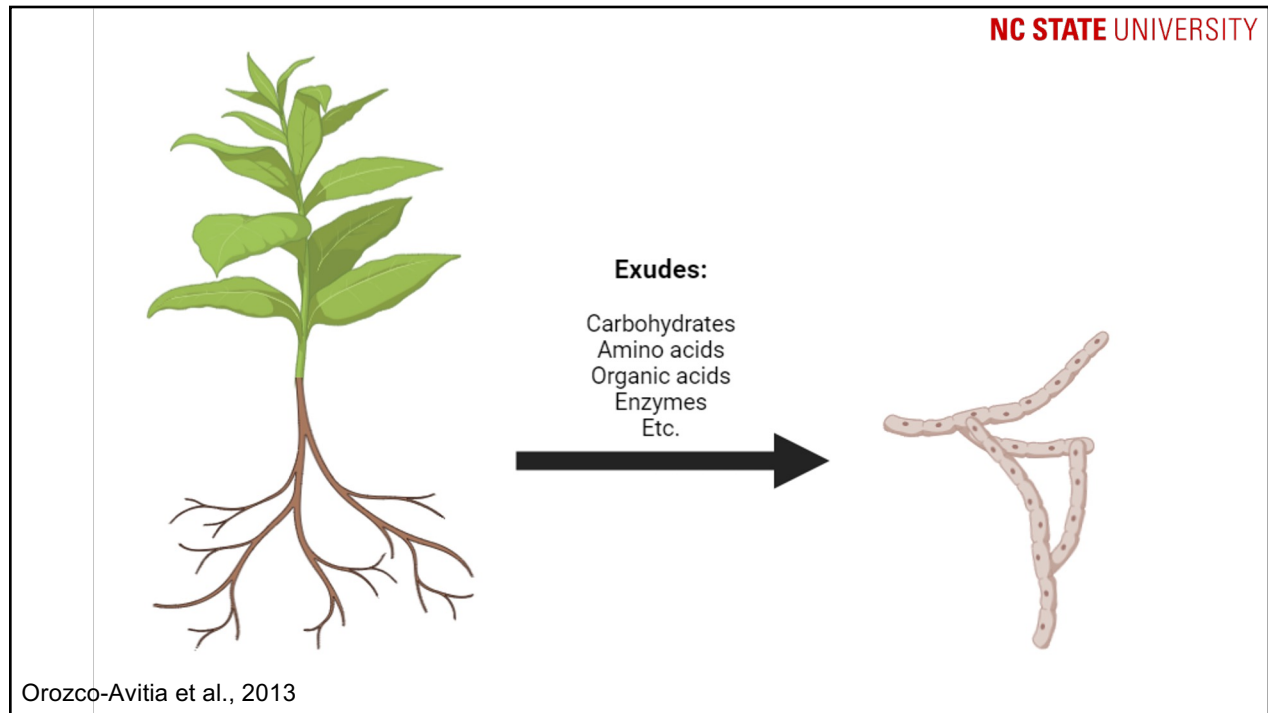
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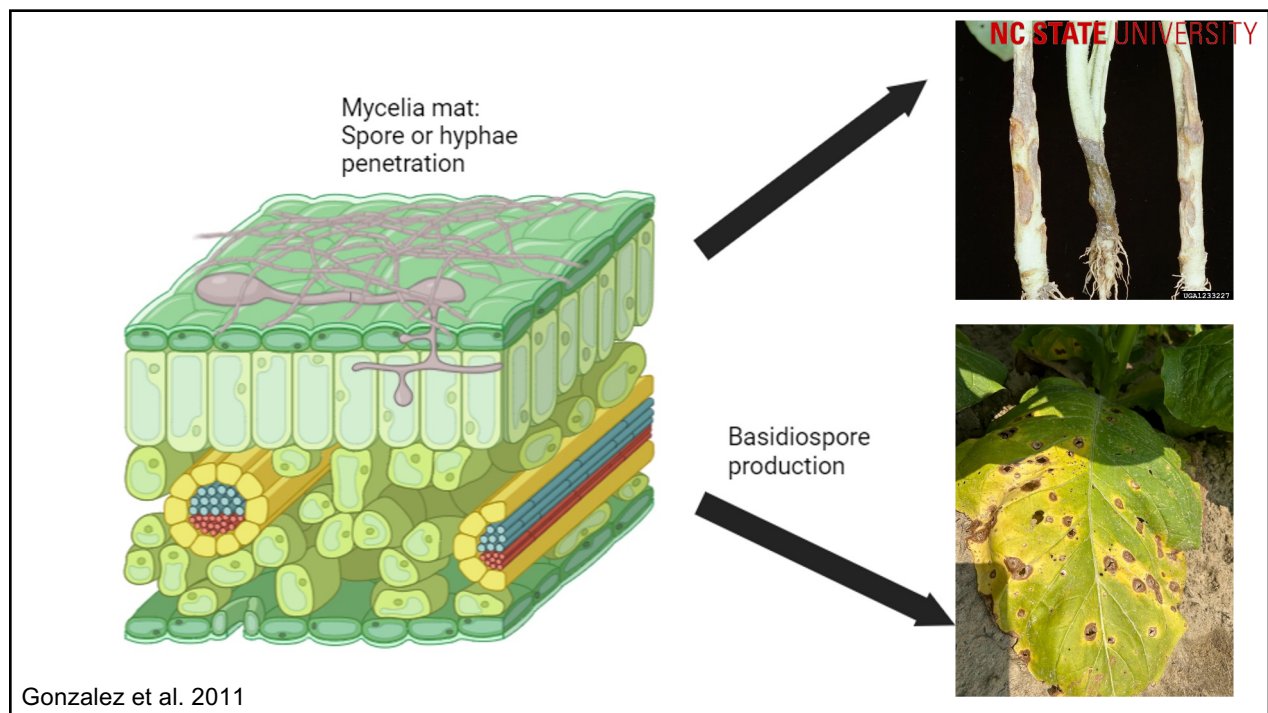
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(Singh 1990)

Fungi grow radially



Why the Concentric Rings?

Darker: Cell death, Enzymes, Melanization

Lighter: Fungal growth

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Table 1. Effect of commercially available fungicides on target spot severity and leaf yield, Rocky Mountain, NC, 2023.

Fungicide	% Severity ^a			Yield ^d	Yield difference	Yield Increase (%)	Price (\$)/lb	Fungicide + application cost / A	ROI / A
	Lower Stalk	Middle Stalk	Upper Stalk						
Untreated	22	9	2	2,420	-	-	-	-	-
Quadris Flowable ^b	10	4	1	2,711	+126	+5%	1.97	85.14	+\$164
Manzate ProStick ^c	12	6	2	2,705	+114	+5%	1.97	101.28	+\$123

^a Treatment means are not significantly different at the $\alpha=0.05$ level.
^b Quadris applied at 4, 6, & 8 weeks after transplanting at 8, 9, & 9 fl oz/a/application.
^c Manzate ProStick applied at 4, 6, & 8 weeks after transplanting at 2 lbs/a/application.
^d Yield data presented from three growing locations in 2023: Rocky Mountain, Kinston, and Oxford.

Data: M. Vann, 2023

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Table 2. Fungicides evaluated in Rocky Mountain, NC, 2024.

Treatment	Product (rate fl oz/A)	Active Ingredient
1	Untreated	Untreated
2	Excalia (2) - Quadris F (8) - Excalia (2)	Inpyrfluxam - Azoxystrobin - Inpyrfluxam
3	Quadris Flowable (8)	Azoxystrobin
4	Quadris F (8) - Manzate P (2 lbs) - Quadris (8)	Azoxystrobin - Mancozeb - Azoxystrobin
5	VJR90 (9)	Azoxystrobin + Fluindapyr + Flutriafol
6	Excalia (2)	Inpyrfluxam
7	Manzate Prostick (2 lbs)	Mancozeb
8	Manzate ProStick (2 lbs) + Howler (2 lbs)	Mancozeb + <i>Pseudomonas chlororaphis</i>
9	Manzate P (2 lbs) - Quadris F (8) - Manzate P (2 lbs)	Mancozeb - Azoxystrobin - Mancozeb
10	Miravis Top (13.7)	Pydiflumetofen + Difenconazole

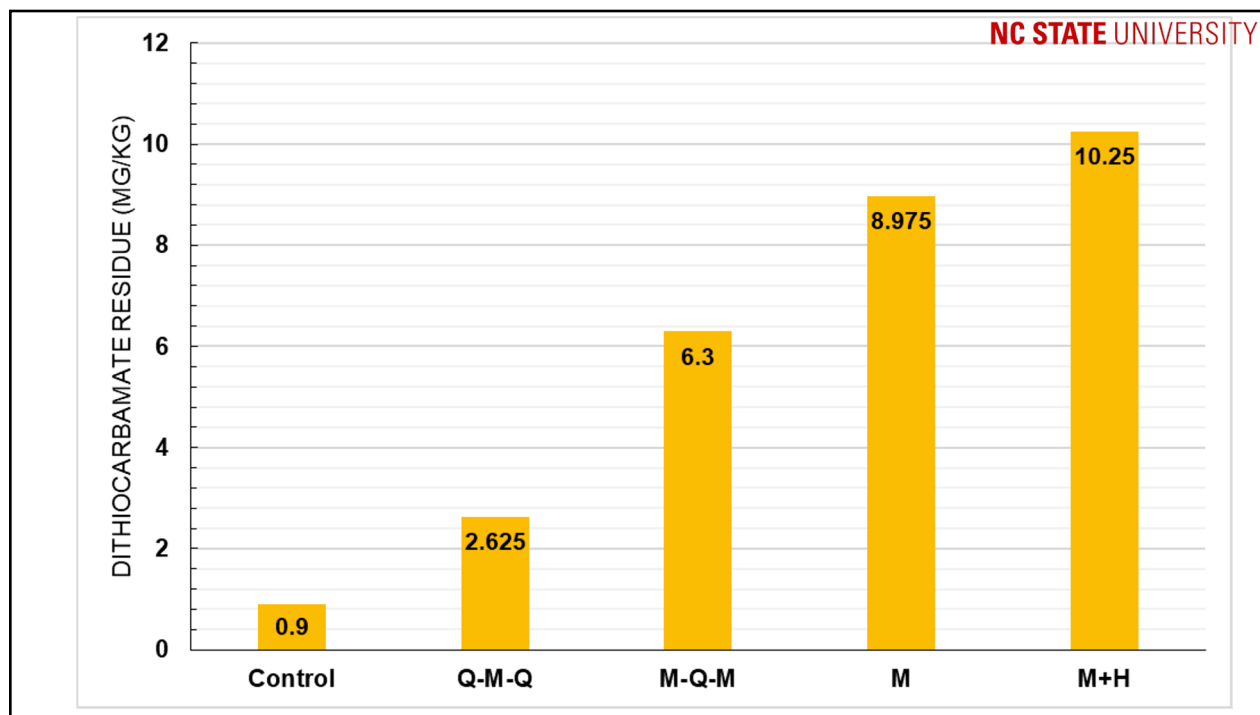
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Table 3. Effect of commercially available fungicides on target spot severity and leaf yield, Rocky Mountain, NC, 2024.

Fungicide (rate)	Severity (AUDPC)			Yield (lbs/A)	Yield Difference (lbs/A)	Yield Difference (%)	Price (\$)/lb	Fungicide + application cost / A	ROI (%)
	Lower	Middle	Upper						
Untreated	26.4	0.1	0.0	3109.1					
Quadris Flowable (8) * 3	19.6	0.2	0.0	3188.1	+79	+2.5	1.97	85.14	\$70.49
Quadris Flowable (8 fl oz/A)									
Manzate ProStick (2 lb/A)	16.8	0.0	0.0	3341.9	+232.8	+7.5	1.97	90.51	\$368.11
Quadris Flowable (8 fl oz/A)									
Manzate Prostick (2 lb/A) * 3	13.0	0.0	0.0	3297.8	+188.7	+6.1	1.97	101.25	\$270.49
Manzate Prostick (2 lb/A) + Howler (2 lb/A) * 3	32.6	1.1	0.0	3201.6	+92.5	+3	1.97	241.26	-\$59.04
Manzate ProStick (2 lb/A)									
Quadris Flowable (8 fl oz/A)	24.0	1.2	0.0	3218.6	+109.5	+3.5	1.97	95.88	\$119.84
Manzate ProStick (2 lb/A)									

^a Fungicides applied at 4, 6, & 8 weeks after transplanting.^bTreatment means are not significantly different at the $\alpha=0.05$ level

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Table 4. Effect of experimental fungicides on target spot severity and leaf yield, Rocky Mountain, NC, 2024.

Do not use chemical controls that are not labelled for your crop. Follow all label guidelines.

Fungicide	Severity (AUDPC)			Yield (lbs/A)	Yield Difference (lbs/A)	Yield Increase (%)
	Lower	Middle	Upper			
Untreated	26.4	0.1	0.0	3109.1		
Excalia - Quadris Flowable - Excalia	16.4	0.0	0.0	3260.3	+151.2	+4.9
Excalia * 3	28.7	0.0	0.0	3006.4	-102.7	-3.3
Miravis Top * 3	10.5	0.0	0.0	3382.7	+273.6	+8.8
VJR90 * 3	12.1	0.0	0.0	3350.0	+240.9	+7.7

^a Fungicides applied at 4, 6, & 8 weeks after transplanting.

^b Treatment means are not significantly different at the $\alpha=0.05$ level

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Table 5. Effect of experimental fungicides on target spot severity and leaf yield, Johnston County, NC, 2024.

Do not use chemical controls that are not labelled for your crop. Follow all label guidelines.

Treatment	AUDPC	Yield (lbs)	% Diff
Untreated	79.2	100.5	
Azoxystrobin (6 fl oz)	77.4	106	5.47%
Inpyrfluxam (2 fl oz)	34.7	99	-1.49%
Inpyrfluxam (2,2,4 fl oz)	123.5	91	-9.45%
Inpyrfluxam (4,2,2 fl oz)	32.1	89.5	-10.95%
Inpyrfluxam (3,2,3 fl oz)	118.2	101	0.50%
Inpyrfluxam (4,4 fl oz)	125.0	95.3	-5.14%

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Table 6. Effect of experimental fungicides on target spot severity and leaf yield, Wilson County, NC, 2024.

Do not use chemical controls that are not labelled for your crop. Follow all label guidelines.

Inpyrfluxam Rate	AUDPC	Yield (lbs)	% Diff
Untreated	436.7	23	
2.67 floz	572.9	26	13.04%
6 floz	398.1	25.5	10.87%
15 floz	455.5	24	4.35%
4 floz	509.7	31	34.78%
8 floz	318.7	25.5	10.87%
20 floz	422.5	22.5	-2.17%

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