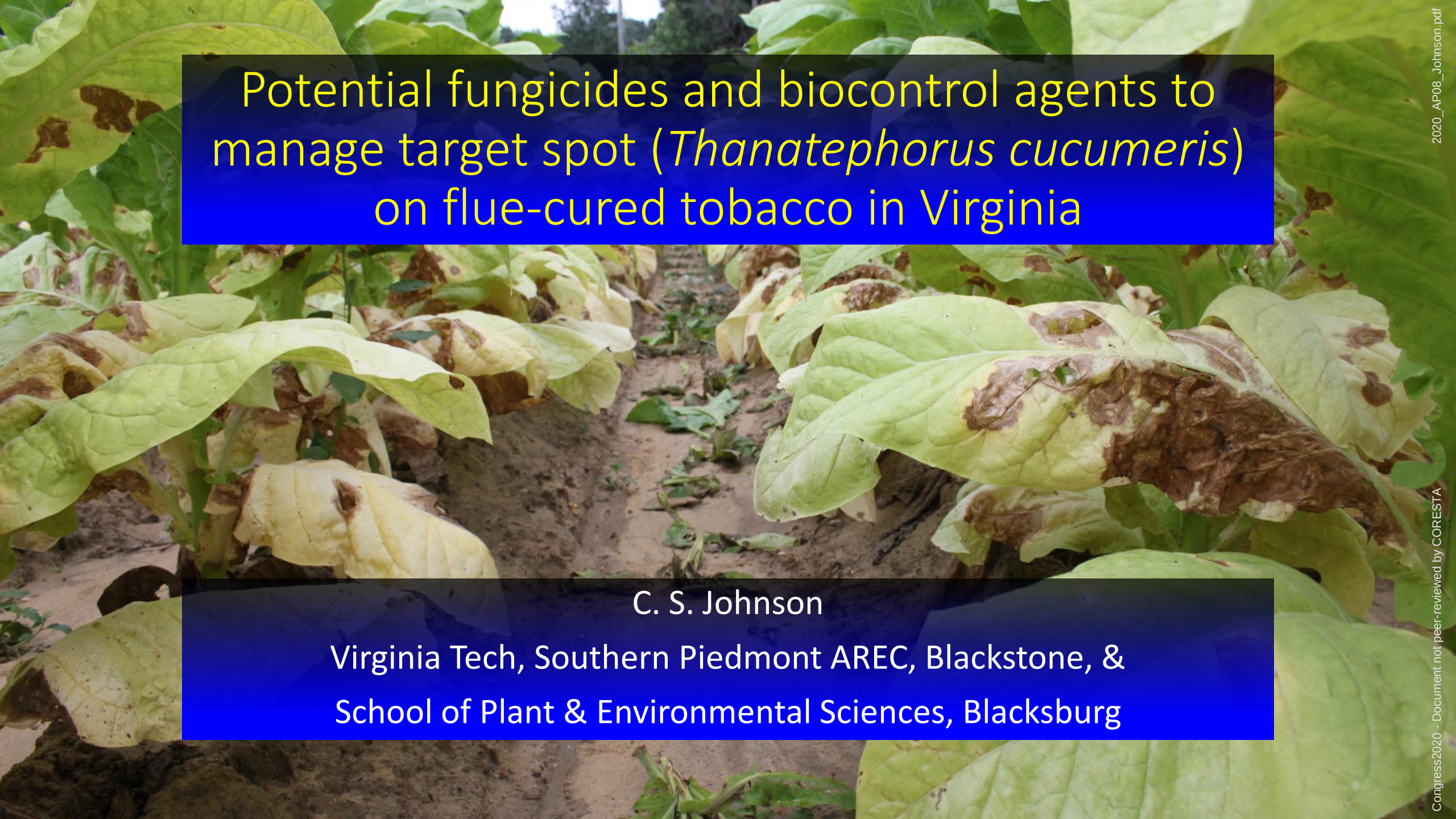

Potential fungicides and biocontrol agents to manage target spot (*Thanatephorus cucumeris*) on flue-cured tobacco in Virginia

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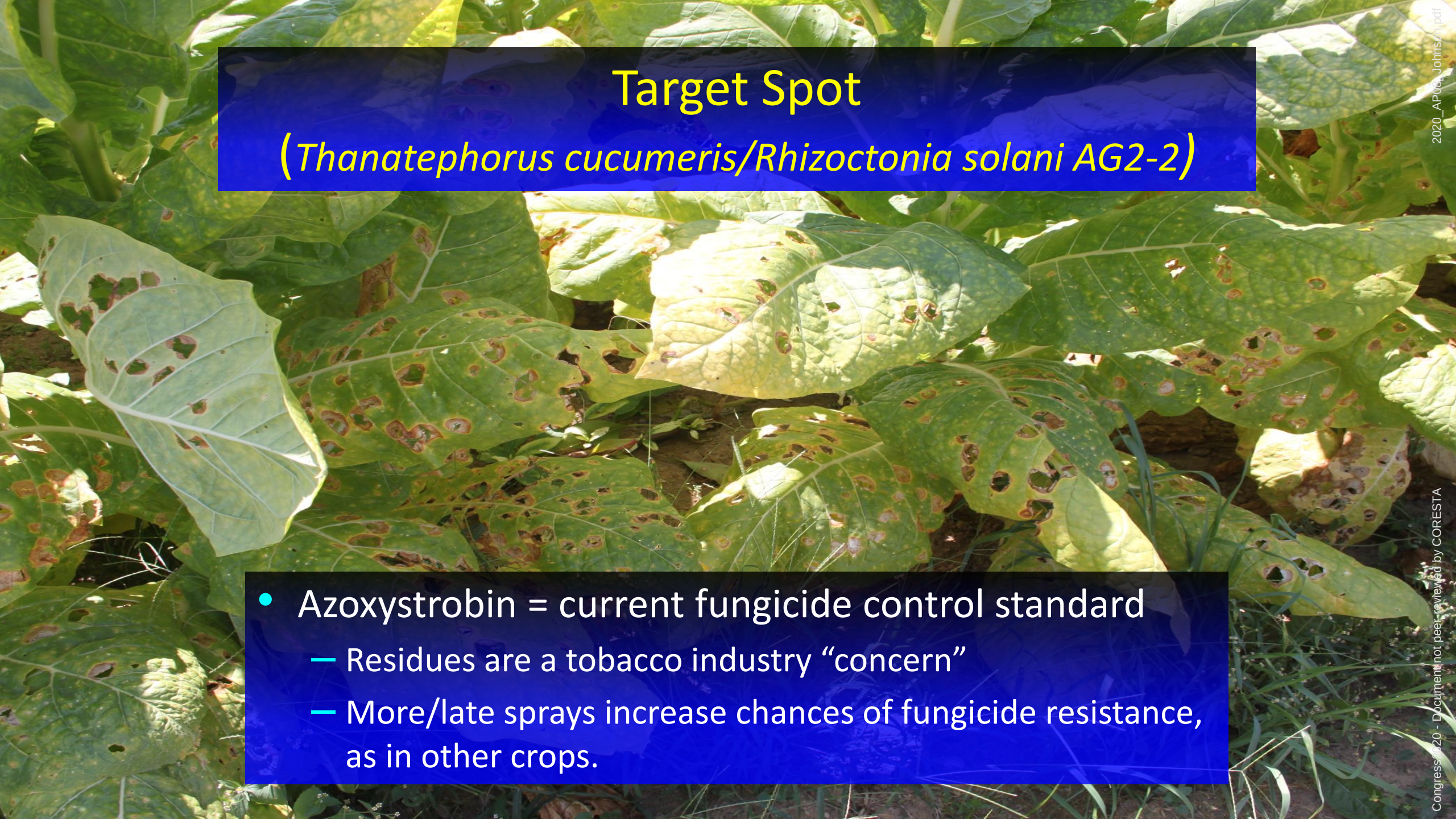
Target Spot

(*Thanatephorus cucumeris/Rhizoctonia solani AG2-2*)



- Azoxystrobin = current fungicide control standard
  - Residues are a tobacco industry “concern”
  - More/late sprays increase chances of fungicide resistance, as in other crops.

2017-2019 Materials & Methods

- Virginia Tech So. Piedmont AREC near Blackstone, VA.
- Included fungicides from FRAC groups 3, 7, 11, P01, M03, & biocontrol agents from FRAC groups P01, P05, P06 & MB02.
- Plots were arranged in a randomized complete block design with 5-6 replications, & consisted of 1 border row on either side of a 12.2 m-long test row on 1.2 m row centers.

2017-2019 Materials & Methods

Product Application

- Spray equipment
  - CO_2-pressurized backpack sprayer, ~174 kPa
  - 3 TX-12, TX-18 tips, 33 cm apart
  - All sprays centered over the row
- Spray volume: ~468 ± 50 L/ha

Materials & Methods

% Leaf Area Damaged (%LAD)

- 4 plants/plot: Plants 4, 8, 12, & 16 in 24-plant plot
- 3 stalk positions: Lower, Middle, Top
- Assume total leaf number = 24, so 8 leaves within each stalk position

Materials & Methods

% Leaf Area Damaged (%LAD)

- % LAD at each stalk position rated directly by 2 raters
- Train raters using standard area diagrams
- Analyzed average rating for each stalk position
- Data arc-sine transformed prior to ANOVA & Waller-Duncan LSD (k-ratio = 100).

Target Spot Fungicide Test Results: 2017

Fungicide Treatment	Mean Product	Application	% Leaf Area Damaged
Active Ingredient (Trade Name)	**Rate(s)/ha**	**Timing***	**(Lower Leaves)**
Inpyrfluxam (Excalia)	141 ml	L, 3WAL, Top	4.2 c
Inpyrfluxam+V-10449	140+120 ml	L, 3WAL, Top	7.4 bc
B. mycoides isolate J alt. Azoxystrobin	145 g,563 ml	2C, L, 3WAL, Top, H1	8.6 abc
Acibenzolar-S-Methyl (Actigard)	32 g	2C, L, 3WAL, Top	9.2 abc
Azoxystrobin, Penthiopyrad (Fontelis)	592, 855 ml	L, Top	9.6 abc
Azoxystrobin (Quadris)	562 ml	L, Top	11.3 ab
Azoxystrobin, Metconazole (Quash)	592 ml, 175 g	L, Top	11.5 ab
Hydrogen peroxide + Peroxyacetic acid	4.7 L	L, 3WAL, Top, H1	12.1 ab
Bacillus mycoides isolate J (Lifegard)	294 g	2C, L, 3WAL, Top, H1	15.1 ab
Untreated Control	.	.	15.4 ab
Reynoutria sachalinensis extract (Regalia)	4.7 L	1&2C,L,3WAL,Top,H1	16.7 a

*2C = 2nd cultivation; L = Layby; 3WAL – 3 wk after Layby; Top = Topping; H1 = 1st harvest

Target Spot Fungicide Test Results: 23 July 2018

Fungicide Treatment	Mean Product	Application	% Leaf Area Damaged
Active Ingredient (Trade Name)	**Rate(s)/ha**	**Timing***	**(Lower Leaves)**
Inpyrfluxam (Excalia)	**153 ml**	**L, 2WAL**	**11.0 d**
Inpyrfluxam+V-10449	**146+132 ml**	**L, 2WAL**	**11.3 d**
B. mycoides (Lifegard) alt Azoxystrobin (Quadris)	**161 g, 606 ml**	**2C, L, 2WAL, Top**	**23.1 cd**
Azoxystrobin (Quadris)	599, 606 ml	L, Top	33.0 a-d
B. mycoides, (*B. mycoides + B. amyloliquefaciens D747)*	183, (190+88 ml)	L, (2WAL, Top)	41.3 abc
B. amyloliquefaciens F727 (Stargus)	4.7-5.1 L	L, 2WAL, Top	50.0 ab
Untreated Control	**.**	**.**	**53.2 ab**
B. amyloliquefaciens F727 (Stargus)	9.6-10.5 L	L, 2WAL, Top	55.6 a
B. mycoides isolate J (Lifegard)	168 ml	L, 2WAL, Top	57.9 a
B. amyloliquefaciens D747 (Double Nickel)	4.9-5.4 L	L, 2WAL, Top	58.8 a

*2C = 2nd cultivation; L = Layby; 2WAL – 2 wk after Layby; Top = Topping

Target Spot Fungicide Test Results: 6 Aug 2018

Fungicide Treatment	Mean Product	Application	% Leaf Area Damaged
Active Ingredient (Trade Name)	**Rate(s)/ha**	**Timing***	**(Lower Leaves)**
Inpyrfluxam (Excalia)+V-10449	**146+132 ml**	**L, 2WAL**	**0.9 c**
Inpyrfluxam (Excalia)	**153 ml**	**L, 2WAL**	**1.0 c**
Azoxystrobin (Quadris)	**599, 606 ml**	**L, Top**	**19.2 bc**
B. mycoides (Lifegard) alt Azoxystrobin (Quadris)	161 g, 606 ml	2C,L,2WAL,Top,H1	26.5 ab
B. mycoides, (*B. mycoides + B. amyloliquefaciens D747)*	183, (190+88 ml)	L, (2WAL, Top)	28.6 ab
B. amyloliquefaciens F727 (Stargus)	4.7-5.1 L	L, 2WAL, Top	34.8 ab
B. mycoides isolate J (Lifegard)	168 ml	L, 2WAL, Top	53.6 ab
B. amyloliquefaciens F727 (Stargus)	4.5 + 4.1 + 4.4 qt	L, 2WAL, Top	64.5 a
Untreated Control	**.**	**.**	**65.7 a**
B. amyloliquefaciens D747 (Double Nickel)	4.9-5.4 L	L, 2WAL, Top	66.0 a

*2C = 2nd cultivation; L = Layby; 2WAL – 2 wk after Layby; Top = Topping; H1 = 1st harvest

Target Spot Fungicide Test Results: 22 July 2019

Fungicide Treatment	Mean Product	Application	% Leaf Area Damaged
Active Ingredient (Trade Name)	**Rate(s)/ha**	**Timing**	**(Lower Leaves)**
Inpyrfluxam (Excalia)	**153 ml**	**L, 2WAL, Top**	**1.0 d**
Inpyrfluxam + Metconazole	**146+132 ml**	**L, 2WAL, Top**	**3.1 d**
Metconazole (Quash)	180 g	L, 2WAL, Top	15.4 c
Fluopyram (Velum), (Azoxystrobin alt. *B. mycoides*)	577ml, (599 ml,161 g)	TPW, (L,2WAL,Top)	19.2 bc
Mancozeb (Penncozeb)	2.3 kg	L, 2WAL, Top	20.8 bc
Biaxen+Flutriafol (Lucento)	361 g	L, 2WAL, Top, H1	26.1 abc
Untreated Control	**.**	**.**	**28.4 abc**
Flutriatol (Topguard)	1.1 L	L, 2WAL, Top	28.4 abc
Azoxystrobin alt. Mancozeb	603ml, 2.3 kg	L, 2WAL, Top	32.4 ab
Azoxystrobin (Quadris)	581 ml	L, Top	33.5 ab
Azoxystrobin (Quadris) alt. *B. mycoides*	596 ml, 159 g	L+2WAL+Top	39.7 a

*2C = 2nd cultivation; L = Layby; 2WAL – 2 wk after Layby; Top = Topping; H1 = 1st harvest

2017-2019 Yield Results
(kg/ha)

Fungicide	Rate	Application				Mean for
Treatment	ml/ha	Timing*	2017	2018	2019	All Years
Inpyrfluxam	146	Layby, 2-3WAL, Topping	3,467 a	3,989 a	4,061 a	3,839
Azoxystrobin	585	Layby, Topping	3,670 a	3,747 ab	3,799 abc	3,739
Untreated Control	.	.	3,622 a	3,502 ab	3,745 abc	3,623

*2-3WAL = 2-3 weeks after Layby

Summary & Conclusions

- Application of inpyrfluxam (FRAC code 7) significantly reduced % Leaf Area Damage due to target spot every year
- Reductions in target spot damage via application of standard fungicide azoxystrobin (FRAC code 11) at layby & topping were rarely statistically significant - fungicide resistance?
- Other fungicides & biocontrol treatments sometimes reduced damage numerically, but rarely resulted in statistically significant differences compared to the untreated control.
- Increased yield across all stalk positions usually resulted from improved target spot control, but such numerical increases were never statistically significant.

Acknowledgements: Philip Morris International, Altria Client Services & Japan Tobacco International

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