Tar Spot Spray Timing Trials

Trial Objective

- Every year since first reported in the United States in 2015, regions of tar spot incidence have expanded. Tar spot has been repeatedly identified in counties where it has been previously reported and continues to expand to nearby counties every year. In 2020, tar spot expanded into new areas that included Missouri, Minnesota, Pennsylvania, and Ontario (Figure 1).
- In severe cases, losses from tar spot of 50 bushels per acre or more have been observed.[1]
- While fungicides have shown effectiveness in managing tar spot, timing of fungicide applications is important in successfully managing this disease.
- The objective of these trials was to determine the effectiveness of fungicide rate and timing on the management of tar spot in corn.

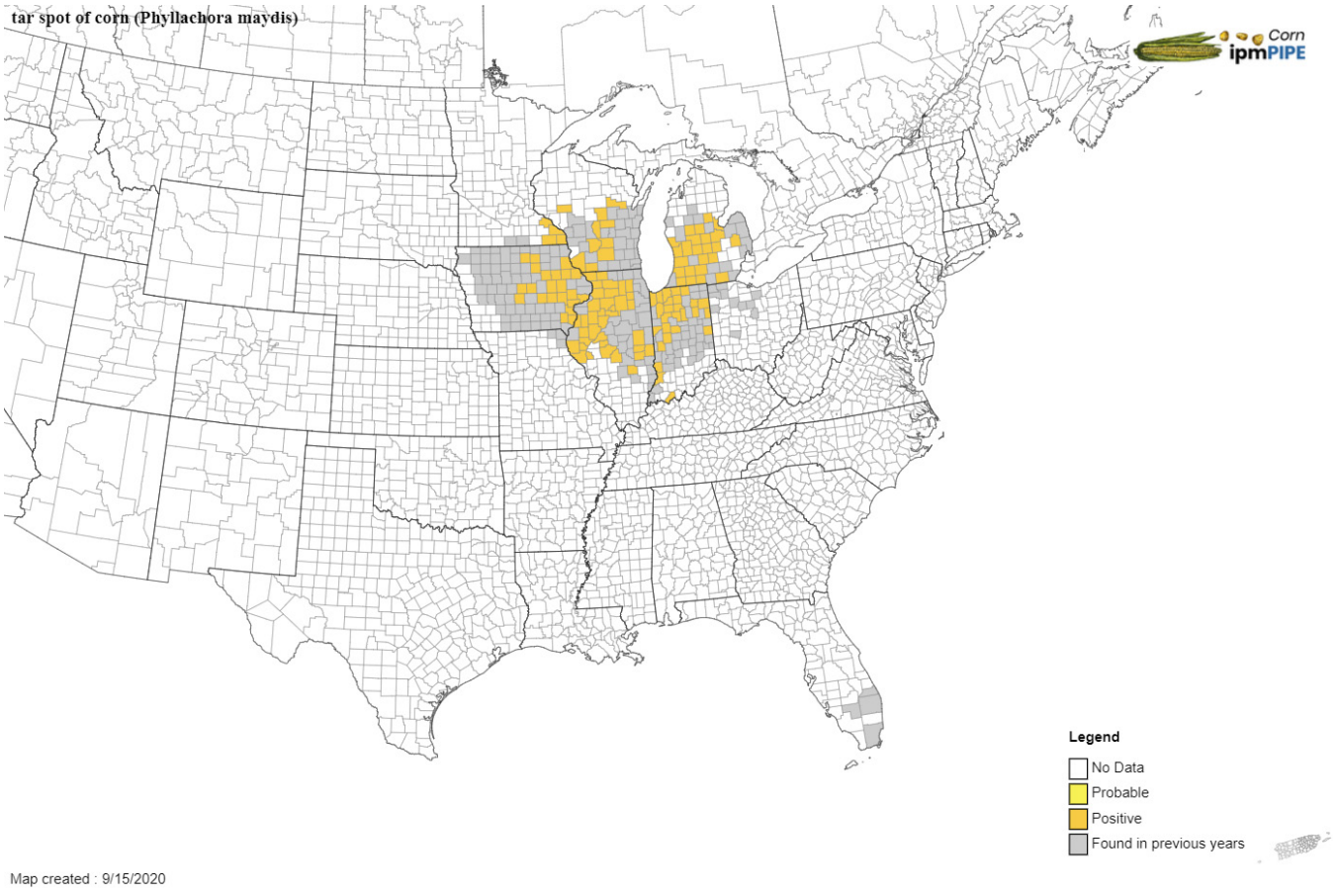

Figure 1. A map of current and previous tar spot infected areas as of May 2021.

Source: https://corn.ipmpipe.org/tarspot/

DISEASES

Tar Spot Spray Timing Trials

Research Site Details

- 2019 University of Illinois Trial (Monmouth, IL)
  - » For this trial, fungicide treatments were applied at the R5 growth stage.
  - » Treatments included:
    - — Nontreated control
    - — Aproach® fungicide
    - — Delaro® 325 SC fungicide
    - — Miravis® Neo fungicide
    - — Tilt® fungicide
  - » The growing season in 2019 was challenging, with early season rains delaying planting, followed by hot, drought conditions from VT through approximately R3.
  - » Cooler, wetter weather in early September favored tar spot development late in the season, within a week of treatment applications.

- 2020 University of Illinois Trial (Monmouth, IL)
  - » For this trial, fungicide treatments were applied at the R3 growth stage.
  - » Treatments included:
    - — Nontreated control
    - — Affiance® Fungicide
    - — Aproach® Fungicide
    - — Aproach® Prima Fungicide 2.34 SC
    - — Delaro® 325 SC fungicide
    - — Miravis® Neo Fungicide
    - — Proline® 480 SC fungicide
    - — Revytek™ Fungicide
    - — Trivapro® Fungicide
    - — Delaro® Complete Fungicide
    - — Veltyma™ Fungicide
    - — Aproach + TILT® fungicide
    - — Tilt® 3.6 EC fungicide
    - — Lucento® Fungicide
    - — Affiance® Fungicide + Badge® SC Fungicide
    - — Domark® 230 ME Fungicide +Badge® SC Fungicide
  - » Disease severity was visually rated as the percent leaf area infected from the ear leaf of five plants located within the center two rows of each plot on September 7 (R5) and September 15.
  - » Tar spot developed rapidly increasing from 9.9% on September 7 to 25.3% on September 15.

Tar Spot Spray Timing Trials

- Effect of Tar Spot in Central Indiana Trial, 2020 (West Lafayette, IN)
  - » For this trial, fungicide treatments were applied at the V7 and VT/R1 growth stages.
  - » Treatments included:
    - — Nontreated Control
    - — Trivapro® 2.21 SE Fungicide
    - — Aproach® Prima 2.34 SC Fungicide
    - — Delaro® Complete Fungicide
    - — Veltyma™ 3.34 S Fungicide
    - — Miravis® Neo 2.5 SE Fungicide
  - » Tar spot stroma visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL).
  - » Tar spot chlorotic and necrotic symptoms visually assessed percentage (0-100%) of leaf area on five plants in each plot at the EL.

- 2019 Tar Spot Strip Trial
  - » This trial included 12 locations.
  - » 7604 Early Relative Maturity (RM) Set:
    - — 99 RM product, Susceptible*
    - — 102 RM product, Less Susceptible*
  - » 7604 Mid Relative Maturity Set:
    - — 113 RM product, Susceptible*
    - — 114 RM product, Less Susceptible*
  - » This trial included five fungicide application timings:
    1. Untreated control
    2. V5 growth stage
    3. R1 growth stage
    4. V5 + R1 growth stage
    5. R1 + R3 growth stage

Tar Spot Spray Timing Trials

- 2020 Tar Spot Strip Trial
  - » This trial included eight locations.
  - » 7606 Early Relative Maturity Set:
    - — 99 RM product, Susceptible*
    - — 102 RM product, Less Susceptible*
  - » 7606 Mid Relative Maturity Set:
    - — 113 RM product, Susceptible*
    - — 114 RM product, Less Susceptible*
  - » This trial included two fungicide treatment blocks:
    - — Delaro® 325 SC Fungicide
    - — Delaro® Complete Fungicide (tank mix of Delaro 325 SC Fungicide + Luna® Privilege Fungicide)
  - » Spray treatments for each block of chemistry included:
    1. Unsprayed
    2. V5-V7 growth stage, application of Delaro® 325 SC Fungicide (6 oz/acre)
    3. V5-V7 growth stage, application of Delaro® 325 SC Fungicide (6 oz/acre) followed by R1 growth stage application of Delaro® Complete Fungicide.
    4. R1 growth stage, application of Delaro® Complete Fungicide.
    5. R1 growth stage, application of Delaro® Complete Fungicide tank mix followed by R3-R4 growth stage application of Delaro® Complete Fungicide.

*All corn products show susceptibility to tar spot. Those considered susceptible show more severe symptoms of tar spot earlier than those considered less susceptible.

Tar Spot Spray Timing Trials

Understanding the Results

2019 University of Illinois Trial

	9/17/19		10/3/19			
Treatment and rate A^{-1}	**Senescence (%)**	**TS[z] (%)**	**Senescence (%)**	**TS (%)**	**Lodging (%)**	**Yield (bu A^{-1})**
Non-treated	23.7	1.2	71.8 a[y]	7.9 a	5	255.3
Aproach® fungicide (6 fl oz)	21.8	1.4	57.3 b	5.5 b	8	270.6
Delaro® 325 SC fungicide (8 fl oz)	26.3	0.3	53.5 b	2.9 cd	3	289.1
Miravis® Neo Fungicide (13.7 fl oz)	16.3	0.1	45.0	1.6 d	3	260.8
TILT® fungicide (2 fl oz)	30.0	0.3	60.0 b	3.7 cd	5	256.8
P >F	NS	NS	<.0001	<.0001	NS	NS

Table 1. 2019 University of Illinois trial results at the Northwestern Illinois Research and Demonstration Center in Monmouth, Illinois. A 110 RM corn product was planted June 3, 2019 and fungicide applied September 3, 2019 at the R5 growth stage. NS = not significant.

- All fungicides tested in this trial reduced tar spot severity and plant senescence relative to non-treated controls on four weeks after application (October 3, 2019).
- Delaro® 325 SC fungicide (8 fl oz), Miravis® Neo Fungicide (13.7 fl oz) and TILT® fungicide (2 fl oz) reduced tar spot severity significantly more than Aproach® fungicide (6 fl oz) four weeks after application.
- Miravis® Neo Fungicide (13.7 fl oz) provided the greatest reduction in plant senescence.
- No significant differences in lodging or yield were detected between fungicide treatments.

Tar Spot Spray Timing Trials

2020 University of Illinois Trial

Treatment	Rate (fl oz A^{-1})	SR 7 Sep (%)		TS 7 Sep (%)		TS 15 Sep (%)		Yield (bu A^{-1})
Non-treated Control		7.6	a	11.2	a	24.4	a	182.5
Affiance® Fungicide	10	0.4	b	3.1	b-f	15.7	bcd	190.0
Aproach® Fungicide	6	1.8	bcd	4.6	bcd	14.2	bcd	198.8
Aproach® Prima Fungicide 2.34 SC	6.8	0.6	cd	1.9	efg	13.1	bcd	176.5
Delaro® 325 SC fungicide	8	0.5	cd	2.2	d-g	5.7	e	202.7
Miravis® Neo Fungicide	13.7	0.8	cd	1.1	g	12.3	cd	183.4
Proline® 480 SC fungicide	5.7	3.2	b	4.6	bcd	18.6	abc	193.4
Revytek™ Fungicide	8	0.4	d	2.8	b-g	5.9	e	186.3
Trivapro® Fungicide	13.7	0.9	cd	5.6	bcd	15.7	bcd	198.6
Delaro® Complete Fungicide	8	0.6	cd	1.8	fg	4.0	e	193.6
Veltyma™ Fungicide	7	2.1	bcd	2.3	c-g	5.7	e	202.4
Aproach + TILT® fungicide	6 + 3	1.7	bcd	4.0	b-f	14.6	bcd	190.0
Tilt® 3.6 EC fungicide	3	6.7	a	5.0	bc	21.3	ab	202.6
Lucento® Fungicide	5	0.6	cd	5.4	b	16.0	bcd	188.4
Affiance® Fungicide + Badge® SC Fungicide	10 + 32	2.2	bc	2.1	d-g	13.3	bcd	195.1
Domark® 230 ME Fungicide + Badge® SC Fungicide	6 + 32	4.5	ab	4.3	b-e	11.7	d	185.0
	P(F)	<0.0001		<0.0001		<0.0001		0.15

Table 2. 2020 University of Illinois trial results at the Northwestern Illinois Research and Demonstration Center in Monmouth, Illinois. A 110 RM corn product was planted April 23, 2019 and fungicide applied July 28, 2020 at the R3 growth stage. Visual ratings of tar spot severity were taken at six weeks (September 7, 2020) and seven weeks (September 15, 2020) after application.

- All fungicides tested in this trial reduced tar spot severity relative to non-treated controls at both rating dates.
- No differences in average yield were detected, which may have been a result of a severe wind event in August that caused some leaning and lodged corn that increased variability in the trial.

Tar Spot Spray Timing Trials

2020 Effect of Tar Spot in Central Indiana Trial

Treatment[z]	Rate/A	Timing	Tar spot % stroma[y] 7-Oct	Tar spot % chlor/nec[x] 7-Oct	Yield[w] bu/A 6-Nov
Nontreated Control			25.60 a	44.75 a	225.8
Trivapro® 2.21 SE Fungicide	13.7 fl oz	VT/R1	4.75 b	3.90 b	221.7
Aproach® Prima 2.34 SC Fungicide	6.8 fl oz	VT/R1	4.90 b	2.70 b	229.1
Delaro® Complete Fungicide	8 fl oz	VT/R1	5.00 b	6.50 b	240.0
Delaro® Complete Fungicide	12 fl oz	VT/R1	2.61 b	1.75 b	221.9
Veltyma™ 3.34 S Fungicide	7 fl oz	VT/R1	2.36 b	0.85 b	227.0
Miravis® Neo 2.5 SE Fungicide	13.7 fl oz	VT/R1	4.65 b	1.45 b	225.3
p-value			<.0001	<.0001	0.4
LSD (0.05)[w]			2.95	7.91	NS

[z]Fungicide treatments were applied on 8-Jul at V7 (tassel) and on 8-Aug at VT/R1 (tassel/silk) growth treatments contained a non-ionic surfactant (Preference® adjuvant) at a rate of 0.25% v/v. [y]Tar spot stroma visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL). [x]Tar spot chlorotic and necrotic symptoms visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL). Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference test (LSD; a=0.05). NS = not significant (a=0.05).

Table 3. Results from the 2020 fungicide timing trial at Purdue Agronomy Center for Research and Education (ACRE) in West Lafayette.[y] Tar spot stroma visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL), ear leaf.[x] Tar spot chlorotic and necrotic symptoms visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL). Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference test (LSD; α=0.05). NS = not significant (α=0.05).

- For this trial, all fungicide treatments tested reduced tar spot symptoms on all leaves assessed. All fungicide treatments increased percent green over nontreated control.
- There were no significant differences between treatments for percent lodging, harvest moisture, test weight and average corn yield.

Tar Spot Spray Timing Trials

2019 Tar Spot Fungicide Timing Strip Trial

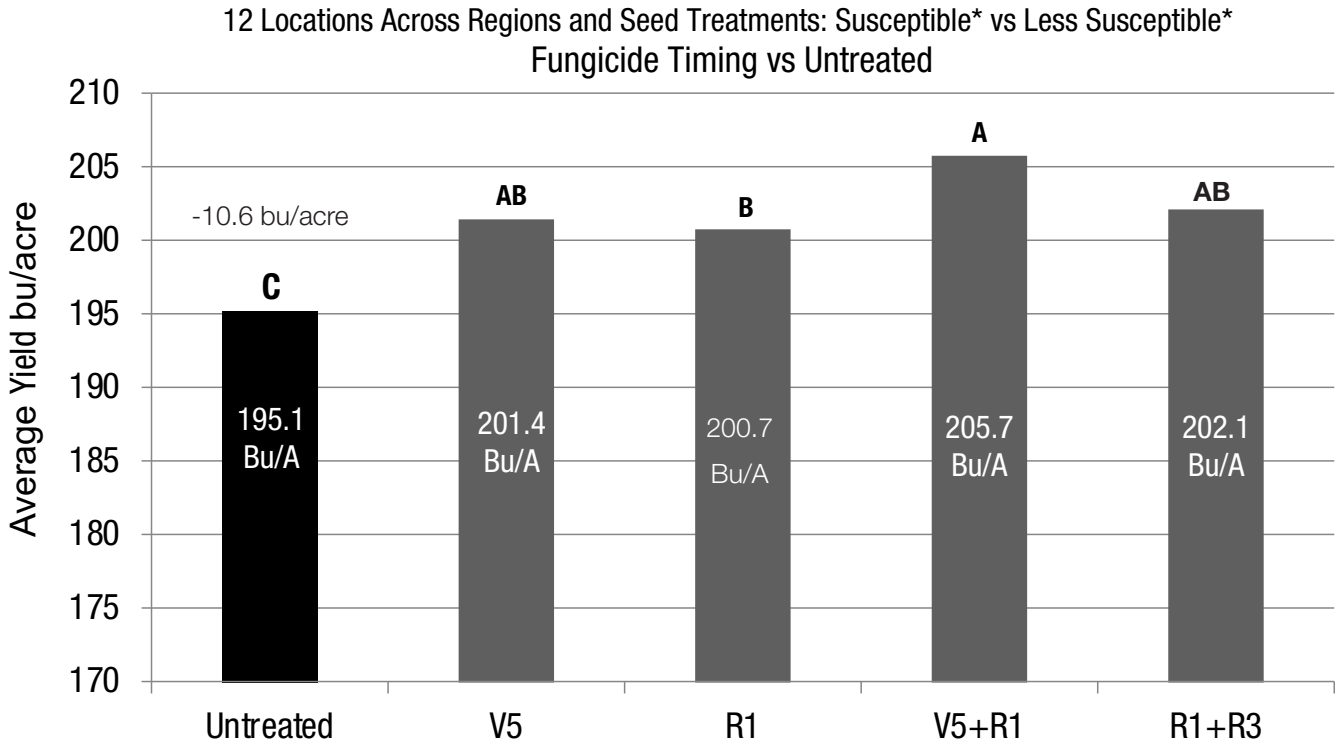

Figure 2. Results from the 2019 tar spot spray timing strip trial, which included 12 locations and tested fungicide application timing on susceptible* and less susceptible* corn products.

- Average yield was across all locations with yield reported.
- Moisture (MST) significant; only 0.3% point wetter for R1 and V5+R1 application timings compared to untreated; across all locations and treatments.
- In 2019, all spray timings responded better than the untreated control in a year with later season infection and lower severity in areas of previous tar spot incidence from the 2018 epidemic.

Tar Spot Spray Timing Trials

2020 Tar Spot Fungicide Timing Strip Trial

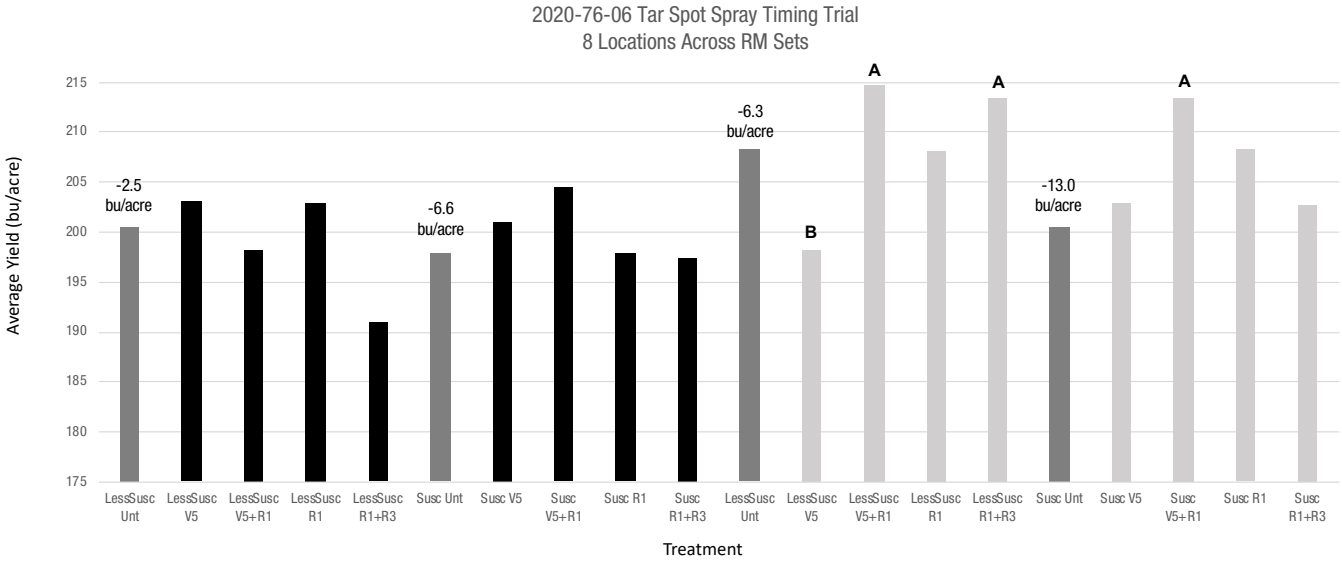

Figure 3. Results from the 2020 tar spot spray timing strip trial, which included eight locations and tested fungicide application timing on early and mid-relative maturity and susceptible* and less susceptible* corn products.

- Average yield reported across all eight locations with yield reported.
- Fungicide treatments did not have a large effect on harvest moisture although moisture was significant at only 0.4% point wetter for the R1+R3 or V5+R1 treatment timings compared to untreated.
- In 2020, most spray timings in this trial responded better than the untreated control in a year with low severity and widespread drought stress later in the season in areas of previous tar spot incidence.
- In this trial, Delaro® Complete (Delaro® 325 SC fungicide + Luna® Privilege Fungicide) had a higher yield response across all locations and treatments.

*All corn products show susceptibility to tar spot. Those considered susceptible show more severe symptoms of tar spot earlier than those considered less susceptible.

Tar Spot Spray Timing Trials

Key Learnings

- Across years, application of a high quality, multiple mode of action fungicide such as Delaro® Complete Fungicide helped to protect yield potential against tar spot compared to the untreated control.
- Timing of fungicide application is critical based on when disease pressure occurs.
- Early and continuous scouting in areas with previously reported disease is important for understanding disease pressure and planning timely fungicide applications if needed.
- Depending on when disease pressure occurs (early- to mid-season or later in the season), multiple fungicide sprays may be warranted.

Sources:

[1] Chilvers, M. July 1, 2020. Tar spot in the spotlight. Michigan State University Extension. https://www.canr.msu.edu/news/tar-spot-in-the-spotlight.

Legal Statements

The information discussed in this report is from a multiple site, non-replicated strip trials. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.

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