Data summary: Fungicide efficacy for management of Ascochtya blight in chickpeas

NDSU Carrington Research Extension Center; Michael Wunsch, Suanne Kallis, Jesse Hafner, Aaron Fauss, Michael Schaefer, Billy Kraft, Thomas Miorini
North Dakota State University Williston Research Extension Center; Audrey Kalil, Edson Ncube, Tyler Tjelde and support staff

METHODS SUMMARY:

Market class = testing was conducted on Kabuli chickpea varieties with partial Ascochyta resistance adapted to the Northern Plains (generally CDC Frontier, CDC Leader, or CDC Orion)

Row spacing = 7 inches

Seeding rate = 4.0, 4.5 or 5.0 viable seeds/square foot

Fungicide spray volume = 15 gal/ac in most studies; 17 or 17.5 gal/ac in some of the early research

Most of the testing was conducted with fungicides applied with a hand-held boom pressurized by CO_2. Some of the testing with Proline vs. Proline + Bravo WS was conducted with a tractor-mounted, PTO-driven sprayer.

Fungicide spray droplet size: fine (2009-2022) or calibrated relative to canopy characteristics (fine, medium or coarse, 2023-2024).

Number of fungicide applications: as needed relative to rainfall patterns; 3, 4, 5, or 6 applications 10-14 days apart, depending on the year.

Application timing in fungicide efficacy studies: First appearance of disease symptoms or early bloom, whichever occurred first. Never prior to late vegetative growth.

Number of experimental replicates = 4, 5 or 6 (depending on the study)

Disease development was facilitated by spreading small quantities of overwintered diseased chickpea residues in non-harvested plots separating treatment plots

Ascochyta disease assessment: Minimum three assessments (concurrent with first fungicide application and then twice during pod-fill, including once shortly before senescence). Disease is reported on a 0 to 100 scale corresponding to disease progress from the first fungicide application to the last disease rating (relative area under the disease progress curve)

Yield: Grain yields were calculated on the basis of the measured plot length at harvest and the grain moisture at harvest and are reported at a standard 13.5% moisture level.

Bravo Weather Stik @ 1.38 pt/ac

FRAC group = M5

active ingredient = chlorothalonil

concentration = 6.0 lbs chlorothalonil/gal

Funding	BASF	Syngenta	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	USDA Specialty Crop Block Grant	USDA Specialty Crop Block Grant	USDA Specialty Crop Block Grant	
Year	2019	2019	2019	2019	2020	2020	2021	2021	2021	2022	2022	2022	
Location	Carrington	Carrington	Carrington	Hofflund	Hofflund	Carrington	Carrington	Carrington	Hofflund	Hofflund	Carrington	Carrington	
Variety	CDC Frontier	CDC Frontier	CDC Frontier	CDC Frontier	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	
First application	late vegetative growth, 3-5% plants with ≥1 Ascochyta lesions	late vegetative growth, 3-5% plants with ≥1 Ascochyta lesions	late vegetative growth, 3-5% plants with ≥1 Ascochyta lesions	bloom initiation, ave. 1.3% Ascochyta severity	bloom initiation, ave. 1.3% Ascochyta severity	90% plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation, 0% Ascochyta	Not recorded	bloom initiation	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	
Number of applications	Five (11-14 days apart)	Five (12-14 days apart)	Five (11-14 days apart)	three (13-15 days apart)	three (13-14 days apart)	four (11-14 days apart)	Three (11-17 days apart)	Three (11-17 days apart)	Three (11-17 days apart)	Four (13-15 days apart)	Three (10-14 days apart)	Three (10-14 days apart)	
Nozzles:	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi	Wilger ER110-015, 40 psi	Wilger ER110-02, 40 psi	XR11002 flat-fan nozzles, 30 psi	XR11002, 30 psi (1st applic.); DG110015, 30 psi (2nd, 3rd applications)	XR11002, 30 psi (1st applic.); DG110015, 30 psi (2nd, 3rd applications)	Wilger ER110-02 @ 40 psi	Wilger ER110-02, 40 psi	XR11002, 30 psi (1st, 2nd applic.); DG110015, 40 psi (3rd applic.)	XR11002, 30 psi (1st, 2nd applic.); DG110015, 40 psi (3rd applic.)	
Droplet size:	fine	fine	fine	fine	fine	fine	fine (1st applic.), medium (2nd & 3rd application)	fine (1st applic.), medium (2nd & 3rd application)	fine	fine	fine	fine	
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	April 25	April 25	April 25	Apr. 24	Apr. 29	May 7-8	April 28	April 28	April 30	May 10	May 16	May 16	
Disease assessments	June 19, July 22, Aug. 22-24	June 18, July 22-23, Sept. 10	June 19, July 23, Sept. 10	three (June 25, July 11, Aug. 5)	June 23, July 6, July 20, Aug. 5	31; Aug 31-Sept 1	June 24, July 8-12, July 28-29	June 24, July 7-8, July 26-27	June 24, July 7, July 21, Aug. 5	July 1, July 6, July 22, Aug. 3	July 28-29, Aug. 5-8	July 28-29, Aug. 5-8	
Harvest date	Oct. 7	Oct. 7	Oct. 30	Sept. 6	Aug. 31	Sept. 23-25	Aug. 18	Aug. 16	Sept. 7	Sept. 1-12	Sept. 6	Sept. 6	
Plot length (at harvest)	ave. 23.8 ft	ave. 24.0 ft	ave. 23.3 ft	ave. 20.5 ft	ave. 17.2 ft	ave. 22.4 ft	ave. 19.0 ft	ave. 16.8 ft	ave. 23.0	ave. 20.5	ave. 19.3	ave. 19.3	COMBINED ANALYSIS 12 studies
Seeding rate	4 viable seeds/sq ft	4 viable seeds/sq ft	4 viable seeds/sq ft	6 viable seeds/sq ft	5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	Not recorded	5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	
Row spacing	7.5 inches	7.5 inches	7.5 inches	7.5 inches	8 inches	7.5 inches	7 inches	7 inches	7 inches	7 inches	7 inches	7 inches	
	Ascochyta (0-100)												Ascochyta
Non-treated	**60** d	**65** b	**65** d	**21** c	**27** b	**69** c	**38** b	**31** c	**41** c	**50** c	**15** b	**13** b	**41** c
Proline 5.7 fl oz/ac	**8** b	**22** b	**12** b	**10** a	**18** a	**53** bc	**16** a	**14** ab	**19** b	**39** b	**5** ab	**2** a	**18** b
Bravo Weather Stik 1.38 pt/ac	**21** c	**46** b	**33** c	**12** b	**18** a	**49** b	**16** a	**18** b	**19** b	**36** b	**6** ab	**3** ab	**23** b
Proline 5.7 fl oz + **Bravo WS** 1.38 pt/ac	**3** a	**2** a	**1** a	**6** a	**14** a	**28** a	**10** a	**9** a	**5** a	**23** a	**3** a	**3** ab	**9** a
CV:	19.9	27.3	35.3	24.1	19.4	19.1	34.4	25.7	15.6	7.9	40.2	38.3	17.3
	Yield (lbs/ac)												Yield
Non-treated	**24** c	**335.5** b	**259** b	**391** c	**1443** c	**514** b	**1290** b	**1414** c	**10** c	**48** b	**2788** b	**2346** b	**905** c
Proline 5.7 fl oz/ac	**1089** ab	**2291** a	**1691** a	**1474** b	**2447** b	**1931** a	**2484** a	**2301** ab	**81** b	**195** b	**3460** a	**3651** a	**1924** b
Bravo Weather Stik 1.38 pt/ac	**445** bc	**1185** b	**1186** ab	**1668** b	**2173** b	**2248** a	**2006** a	**1907** bc	**108** b	**165** b	**3051** ab	**3314** ab	**1621** b
Proline 5.7 fl oz + **Bravo WS** 1.38 pt	**1893** a	**2253** a	**1983** a	**2564** a	**3087** a	**2870** a	**2577** a	**2609** a	**685** a	**1122** a	**3618** a	**3709** a	**2414** a
CV:	51.7	21.8	28.6	12.1	13.8	25.5	14.8	12.6	16.2	28.1	8.4	11.4	18.3

Proline @ 5.7 fl oz/ac + **Bravo Weather Stik** @ 1.38 pt/ac

Proline: FRAC group = 3, active ingredient = prothioconazole (4.0 lbs a.i./gal)
Bravo Weather Stik: FRAC group = M5, active ingredient = chlorothalonil (6.0 lbs a.i./gal)

Combined analysis across 59 replicated field studies conducted in Carrington, Hofflund and Plaza, ND (2015-2023). Fungicides were applied in 15 gal/ac with a hand-held boom or in 15 gal/ac at 6.0, 10.0 or 10.5 mph with a tractor-mounted sprayer.

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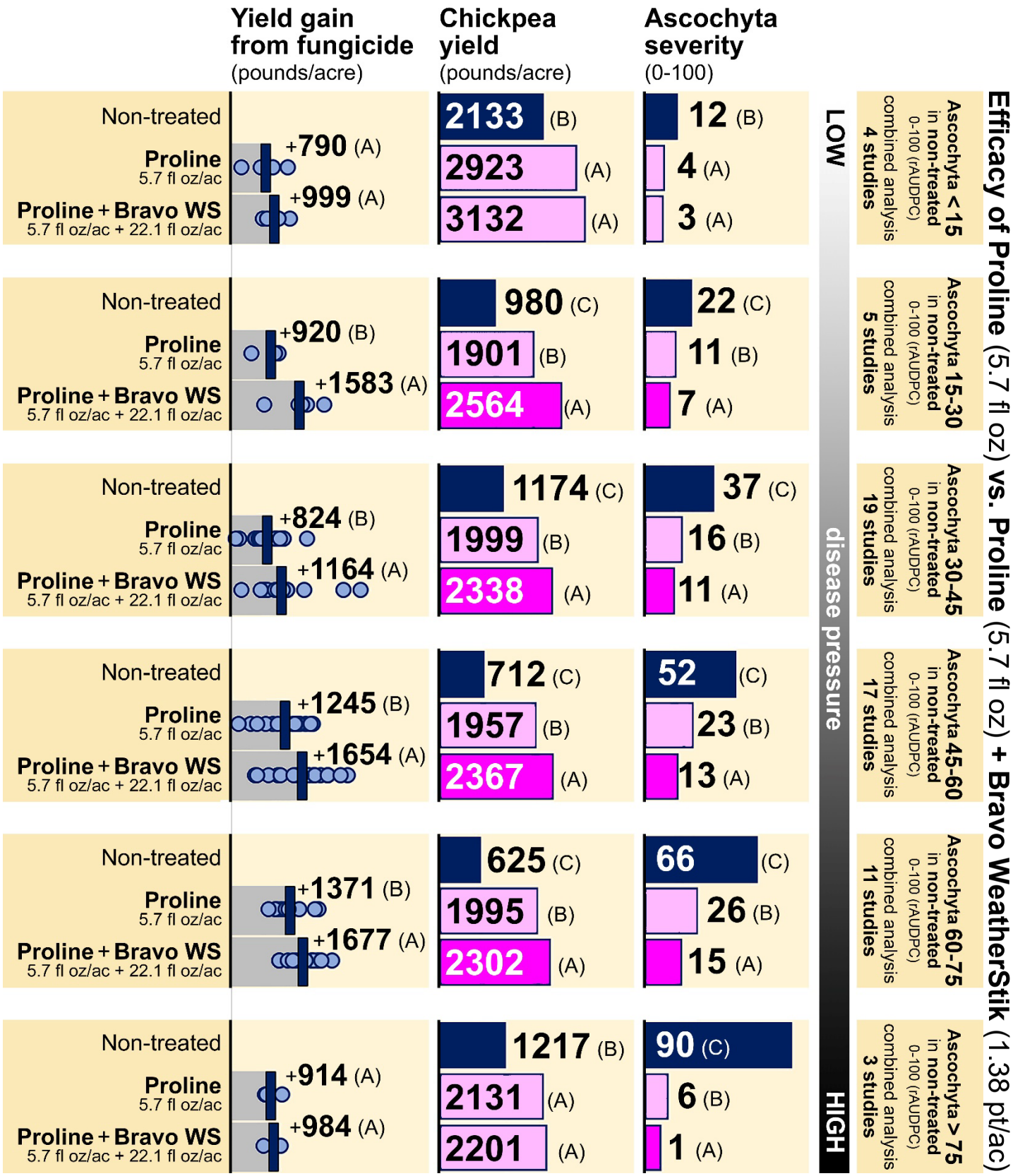
Efficacy of Proline (5.7 fl oz) vs. Proline (5.7 fl oz) + Bravo WeatherStik (1.38 pt/ac)



Optimizing tank-mix application rates

Proline, 5.0 or 5.7 fl oz/ac + **Bravo WS,** 1.38 or 2.0 pt/ac

Proline: FRAC group = 3
active ingredient = prothioconazole (4.0 lbs a.i./gal.)

Bravo WS: FRAC group = M5
active ingredient = chlorothalonil (6.0 lbs a.i./gal.)

Funding	BASF	NPGA, Harmonization Board	NPGA, Harmonization Board	NPGA, Harmonization Board	NPGA, Harmonization Board	USDA Specialty Crop Grant	USDA Specialty Crop Grant
Year	2019	2020	2020	2021	2021	2022	2022
Location	Carrington, ND	Hofflund, ND	Carrington, ND	Carrington, ND	Hofflund, ND	Hofflund, ND	Carrington, ND
Variety	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion
First application	late vegetative growth, 3-5% of plants with ≥1 Ascochyta lesions	bloom initiation, average 1.3% Ascochyta severity	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation; Ascochyta disease level not recorded	bloom initiation; Ascochyta disease level not recorded	5% of plants in bloom, 5% of plants with ≥1 Ascochyta lesions
Number of applications	Five (11-14 days apart)	Three (13-14 days apart)	Four (11-14 days apart)	Three (11-17 days apart)	Three (14-16 days apart)	Four (13-14 days apart)	Four (13-15 days apart)
Nozzles:	TeeJet XR11002, 30 psi	Wilger ER110-02, 40 psi	XR11002, 30 psi	XR11002, 30 psi (app #1); DG110015 30 psi (app 2, 3)	Wilger ER110-02, 40 psi	Wilger ER110-02, 40 psi	XR11002, 30 psi
Spray droplet size:	fine	fine	fine	fine (app 1), med (app 2, 3)	fine	fine	fine
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac
Planting date	April 25	Apr. 29	May 7-8	April 28	April 30	May 10	May 16
Disease assessments	June 19, July 22, Aug. 22-24	June 23, July 6, July 20, Aug. 5	June 26; July 30-31; Aug. 31-Sept. 1	June 24, July 7-8, July 26-27	June 24, July 7, July 21, Aug. 5	July 1, July 6, July 22, Aug. 3	July 28-29, Aug. 5-8
Harvest date	Oct. 7	Aug. 31	Sept. 23-25	Aug. 16	Sept. 7	Sept. 1-12	Sept. 6
Plot length (at harvest)	ave. 23.8 ft	ave. 17.2 ft	ave. 22.4 ft	ave. 16.8 ft	ave. 23.0	ave. 20.5	ave. 19.3 ft
Seeding rate	4.0 viable seeds/sq ft	5.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	Not specified	5.0 viable seeds/sq ft	4.5 viable seeds/sq ft
Row spacing	7.5 inches	8 inches	7.5 inches	7 inches	7 inches	7 inches	7 inches

Year	**2019**	**2020**	**2020**	**2021**	**2021**	**2022**	**2022**	COMBINED ANALYSIS 7 studies
Location	Carrington	Hofflund	Carrington	Carrington	Hoffland	Hofflund	Carrington	
Variety	Frontier	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	
Number of fungicide applications	5	3	4	3	3	4	3	
	Ascochyta (0-100)							**Ascochyta** (0-100)
Non-treated	**60** e	**27** b	**69** g	**31** c	**41** d	**50** d	**15** b	**42** e
Bravo WS 1.38 pt/ac	**21** d	**18** a	**49** c-f	**18** b	**19** c	**36** bc	**6** ab	**24** d
Bravo WS 2 pt/ac	**6** bc	**15** a	**44** b-e	**18** b	**15** c	**34** b	**6** ab	**20** bcd
Proline 5.0 fl oz/ac	**9** c	**19** a	**62** efg	**14** ab	**16** c	**39** c	**5** ab	**23** cd
Proline 5.7 fl oz/ac	**8** c	**18** a	**53** d-g	**14** ab	**19** c	**39** c	**5** ab	**22** cd
Proline 5.0 fl oz + **Bravo WS** 1.38 pt/ac	**3** ab	**16** a	**27** ab	**11** ab	**6** b	**23** a	**3** a	**13** abc
Proline 5.7 fl oz + **Bravo WS** 1.38 pt/ac	**3** a	**14** a	**28** ab	**9** a	**5** ab	**23** a	**3** a	**12** ab
Proline 5.0 fl oz + **Bravo WS** 2.0 pt/ac	**3** a	**16** a	**25** ab	**11** ab	**5** ab	**23** a	**2** a	**12** a
Proline 5.7 fl oz + **Bravo WS** 2.0 pt/ac	**3** ab	**16** a	**27** ab	**11** ab	**3** a	**22** a	**3** a	**12** a
CV:	19.9	19.4	19.1	25.7	15.6	7.9	40.2	54.6
	Yield (lbs/ac)							**Yield** (lbs/ac)
Non-treated	**24** d	**1443** d	**514** c	**1414** d	**10** c	**48** c	**2788** c	**892**
Bravo WS 1.38 pt/ac	**445** d	**2173** bc	**2248** ab	**1907** cd	**108** b	**165** c	**3051** bc	**1442** c
Bravo WS 2 pt/ac	**705** cd	**2421** abc	**2045** ab	**1986** bc	**254** ab	**246** c	**3323** abc	**1569** c
Proline 5.0 fl oz/ac	**1127** bcd	**2115** c	**2139** ab	**2184** abc	**84** b	**183** c	**3496** ab	**1618** c
Proline 5.7 fl oz/ac	**1089** bcd	**2447** abc	**1931** ab	**2301** abc	**81** b	**195** c	**3460** ab	**1643** bc
Proline 5.0 fl oz + **Bravo WS** 1.38 pt/ac	**1606** abc	**2764** abc	**2578** a	**2570** abc	**530** a	**1078** b	**3803** a	**2133** a
Proline 5.7 fl oz + **Bravo WS** 1.38 pt/ac	**1893** ab	**3087** a	**2870** a	**2609** ab	**685** a	**1122** b	**3618** ab	**2269** a
Proline 5.0 fl oz + **Bravo WS** 2.0 pt/ac	**2167** ab	**2616** abc	**2157** ab	**2460** a	**429** a	**1272** ab	**3723** a	**2118** ab
Proline 5.7 fl oz + **Bravo WS** 2.0 pt/ac	**2269** a	**2789** ab	**2628** a	**2549** a	**649** a	**1584** a	**3705** a	**2310** a
CV:	51.7	13.8	25.5	12.6	16.2	28.1	8.4	20.3

Efficacy of generic vs. branded chlorothalonil tank-mixed with Proline (5.7 fl oz) or Provysol (3 fl oz)

Bravo WS vs generic chlorothalonil

Proline @ 5.7 fl oz or **Provysol** @ 3.0 fl oz + **Bravo WS, Equus 720 or Praiz** @ 1.38 pt/ac

	Proline: FRAC group = 3 active ingredient = prothioconazole (4.0 lbs a.i./gal.)			**Provysol: FRAC group = 3** mefentrifluconazole (3.34 lbs a.i./gal.)			**Bravo WS: FRAC group = M5** chlorothalonil (6.0 lbs a.i./gal.)		
Funding	BASF	BASF	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	USDA Specialty Crop Block Grant	USDA Specialty Crop Block Grant	Harmonization Board
Year	2020	2021	2020	2020	2021	2021	2022	2022	2023
Location	Carrington, ND	Carrington, ND	Hofflund, ND	Carrington, ND	Carrington, ND	Hofflund, ND	Hofflund, ND	Carrington, ND	Carrington, ND
Variety	'CDC Orion'	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Leader
First application	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation, average 1.3% Ascochyta severity	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation; Ascochyta disease level not recorded	bloom initiation; Ascochyta disease level not recorded	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% plants with ≥1 Ascochyta lesions
Number of applications	four (11-14 days apart)	Three (11-17 days apart)	three (13-14 days apart)	four (11-14 days apart)	Three (11-17 days apart)	Three (14-16 days apart)	Four (13-14 days apart)	Four (13-15 days apart)	Four (10-15 days apart)
Nozzles:	XR11002, 30 psi	XR11002, 30 psi	Wilger ER110-02, 40 psi	XR11002, 30 psi	XR11002m 30 psi (1st applic.); DG110015, 30 psi (2nd, 3rd applic.)	Wilger ER110-02, 40 psi	Wilger ER110-02, 40 psi	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)
Spray droplet size:	fine	fine (1st applic.), medium (app #2, 3)	fine	fine	fine (1st applic.), medium (app #2, 3)	fine	fine	fine	fine (applic. #1, 2), medium (app #3, 4)
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac
Planting date	May 7-8	April 28	Apr. 29	May 7-8	April 28	April 30	May 10	May 16	May 18
Disease assessments	June 26; July 30-31; Aug. 31-Sept. 1	June 24, July 5, July 23	June 23, July 6, July 20, Aug. 5	June 26; July 30-31; Aug. 31-Sept. 1	June 24, July 7-8, July 26-27	June 24, July 7, July 21, Aug. 5	July 1, July 6, July 22, Aug. 3	July 28-29, Aug. 5-8	Sept. 1-2
Harvest date	Sept. 23-25	Aug. 17	Aug. 31	Sept. 23-25	Aug. 16	Sept. 7	Sept. 1-12	Sept. 6	Sept. 20
Plot length (at harvest)	ave. 22.4 ft	ave. 19.7 ft	ave. 17.2 ft	ave. 22.4 ft	ave. 16.8 ft	ave. 23.0	ave. 20.5	ave. 19.3 ft	ave. 17.9 ft
Seeding rate	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	5.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	Not specified	5.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft
Row spacing	7.5 inches	7.0 inches	8.0 inches	7.5 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches

Year	**2020**	**2021**	**2020**	**2020**	**2021**	**2021**	**2022**	**2022**	**2023**	COMBINED ANALYSIS
Location	Carrington	Carrington	Hofflund	Carrington	Carrington	Hofflund	Hofflund	Carrington	Carrington	9 studies
Variety	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Leader	
Number of sequential fungicide applications	4	3	3	4	3	3	4	3	4	
	Ascochyta (0-100)									
FUNGICIDE:	**Provysol**, 3 fl oz	**Provysol**, 3 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	
Non-treated	**73** c	**25** b	**27** b	**69** b	**31** b	**41** c	**50** c	**15** b	**93** c	**47** c
Proyvsol 3 fl oz OR **Proline** 5.7 fl oz/ac	**39** b	**13** a	**18** a	**53** b	**14** a	**19** b	**39** b	**5** ab	**9** b	**23** b
Provysol or Proline + **Bravo WS 1.38 pt/ac**	**20** a	**9** a	**14** a	**28** a	**9** a	**5** a	**23** a	**3** a	**0** a	**12** a
Provysol or Proline + **Praiz 1.38 pt/ac**	**25** ab	**8** a	**15** a	**30** a	**10** a	**3** a	**25** a	**5** ab	**0** a	**14** ab
Provysol or Proline + **Equus 720 1.38 pt/ac**	**19** a	**10** a	**15** a	**24** a	**12** a	**4** a	**22** a	**1** a	**2** a	**12** ab
CV:	15.9	28.9	19.4	19.1	25.7	15.6	7.9	40.2	29.1	19.0
	Yield (lbs/ac)									
FUNGICIDE:	**Provysol**, 3 fl oz	**Provysol**, 3 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	**Proline**, 5.7 fl oz	
Non-treated	**202** b	**1123** a	**1443** b	**514** b	**1414** b	**10** c	**48** b	**2788** b	**1032** b	**953** b
Proyvsol 3 fl oz OR **Proline** 5.7 fl oz/ac	**2824** a	**1710** a	**2447** a	**1931** a	**2301** a	**81** b	**195** b	**3460** a	**1831** ab	**1864** a
Provysol or Proline + **Bravo WS 1.38 pt/ac**	**2727** a	**1261** a	**3087** a	**2870** a	**2609** a	**685** a	**1122** a	**3618** a	**2181** a	**2240** a
Provysol or Proline + **Praiz 1.38 pt/ac**	**2624** a	**1485** a	**2924** a	**2652** a	**2725** a	**561** a	**954** a	**3547** a	**1868** a	**2149** a
Provysol or Proline + **Equus 720 1.38 pt/ac**	**3244** a	**1804** a	**2575** a	**2371** a	**2547** a	**687** a	**1219** a	**3534** a	**2240** a	**2247** a
CV:	31.3	25.4	13.8	25.5	12.6	16.2	28.1	8.4	22.1	20.3

Delaro, 12 fl oz/ac

FRAC groups 3, 11; active ingredients = prothioconazole + trifloxystrobin
concentration = 1.49 lbs prothioconazole/gal + 1.27 lbs trifloxystrobin/gal

Funding	NPGA and Harmonization Board	Bayer	FMC
Year	2019	2023	2023
Location	Carrington	Carrington, ND	Carrington, ND
Variety	CDC Leader	CDC Leader	CDC Leader
First application	late vegetative growth, 3-5% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% plants with ≥1 Ascochyta lesions
Number of applications	Five (11-14 days apart)	Four (10-15 days apart)	Four (10-15 days apart)
Nozzles:	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)
Droplet size:	fine	fine (applic. 1, 2); medium (applic. 3,4)	fine (applic. 1, 2); medium (applic. 3,4)
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac
Planting date	April 25	May 18	May 18
Disease assessments	June 19, July 23, Sept.	Aug. 31-Sept.1	Aug. 3, Aug. 30
Harvest date	Oct. 30	Sept. 20	Sept. 20
Plot length (at harvest)	ave. 23.3 ft	ave. 18.1 ft	ave. 18.1 ft
Seeding rate	4 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft

Delaro @ 12 fl oz/ac delivers the same amount of prothioconazole as Proline @ 4.5 fl oz/ac

	Ascochyta (0-100)			COMBINED ANALYSIS 3 studies
				Ascochyta
Non-treated	**65** c	**88** c	**30** b	**61** b
Proline 5.7 fl oz/ac	**12** ab	**5** b	**4** a	**7** a
Delaro 12 fl oz/ac	**20** b	**8** b	**10** a	**13** a
CV:	43.2	15.1	9.2	22.1
	Yield (lbs/ac)			Yield
Non-treated	**259** b	**1494** b	**1809** b	**1187** b
Proline 5.7 fl oz/ac	**1691** a	**2670** a	**3014** a	**2459** a
Delaro 12 fl oz/ac	**1702** a	**2503** a	**2784** a	**2330** a
CV:	12.8	11.1	32.6	7.1

Endura @ 6.0 oz/ac

FRAC group = 7

active ingredient = boscalid concentration = 70% boscalid by weight

Funding	Bayer	Bayer	NPGA and Harmonization Board	NPGA and Harmonization Board	None	BASF	Harmonization Board	
Year	2009	2010	2013	2019	2019	2023	2024	
Location	Carrington	Carrington	Hofflund	Carrington	Carrington	Carrington	Carrington, ND	
Variety	Sierra	Sierra	CDC Frontier	CDC Leader	CDC Leader	CDC Leader	CDC Leader	
First application	late vegetative growth, Ascochyta at trace levels	late vegetative growth, trace levels of disease	10% of plants with an open blossom, Ascochyta at trace levels	late vegetative growth, 3-5% of plants with 1+ Ascochyta lesions	late vegetative growth, 3-5% of plants with 1+ Ascochyta lesions	bloom initiation, 0.1% incidence of plants with 1+ Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	Three (14-15 days apart)	Four, 13-14 days apart	Three (13-17 days apart)	Five (11-14 days apart)	Five (11-14 days apart)	Four (10-15 days apart)	Six (10-14 days apart)	
Nozzles:	XR80015 flat-fan, 35 psi	TJ60-8002 twin-jet, 35 psi	XR8002 flat-fan, 40 psi	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi (app 4, 5); AIXR1100015 50 psi (app 6)	
Droplet size:	fine	very fine	fine	fine	fine	fine (applic. 1, 2), medium (applic. 3, 4)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)	
Spray volume:	17 gal/ac	17 gal/ac	20 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	May 22	May 18	May 6	April 25	April 25	May 18	Apr 23	
Disease assessments	June 30, July 15, July 2	Three (June 25, Aug. 6,	July 8, July 23, Aug. 12	June 19, July 23, Sept.	June 19, July 23, Sept.	Aug. 31-Sept.1	July 26, Aug. 13, Aug. 27	
Harvest date	Sept. 24	Sept. 27	Sept. 16	Oct. 30	Oct. 30	Sept. 20	Sept. 24	COMBINED ANALYSIS 7 studies
Plot length (at harvest)	ave. 18 ft	ave. 18.9 feet	approx. 14 ft	ave. 23.3 ft	ave. 23.2 ft	ave. 18.1 ft	ave. 23.0	
Seeding rate	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.0 viable seeds/sq ft	4.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 pls/sq ft	
Row spacing	7.0 inches	7.0 inches	7.5 inches	7.5 inches	7.5 inches	7.0 inches	7", 7 rows/plot	
	Ascochyta (0-100)							Ascochyta
Non-treated	**59** c	**43** b	**28** b	**65** c	**53** c	**91** b	**63** b	**57** b
Proline 5.7 fl oz/ac	**3** a	**5** a	**5** a	**12** a	**30** a	**5** a	**16** a	**11** a
Endura 6.0 oz/ac	**16** b	**4** a	**6** a	**34** b	**40** b	**89** b	**65** b	**36** b
CV:	16.2	12.1	29.9	35.3	9.2	31.7	12.3	49.0
	Yield (lbs/ac)							Yield
Non-treated	**0** b	**551** b	**1448** b	**259** b	**251** b	**1125** b	**6** b	**520** b
Proline 5.7 fl oz/ac	**3820** a	**3820** a	**2381** a	**1691** a	**1344** a	**1892** a	**217** a	**2166** a
Endura 6.0 oz/ac	**114** b	**3776** a	**2565** a	**1177** ab	**1298** a	**1528** ab	**27** b	**1498** ab
CV:	15.1	8.3	11.4	28.6	32.6	21.0		64.6

Miravis Neo @ 13.7 fl oz/ac

FRAC group = 3, 7, 11
active ingredients = pydiflumetofen (FRAC 7), azoxystrobin (FRAC 11), propiconazole (FRAC 3)
concentration = 0.63 lb/gal pydiflumetofen , 0.83 lb/gal azoxystrobin, 1.04 lb/gal propiconazole

Funding	Syngenta	Syngenta	Syngenta	Harmonization Board & NPGA	Harmonization Board & NPGA	USDA Specialty Crop Block Grant	BASF	Corteva	Minor Use	Harmonization Board	
Year	2017	2018	2019	2020	2021	2022	2023	2023	2023	2024	
Location	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington, ND	
Variety	CDC Frontier	CDC Frontier	CDC Leader	CDC Orion	CDC Orion	CDC Orion	CDC Leader	CDC Leader	CDC Leader	CDC Leader	
First application	20% of plants with an open blossom, 2% Ascochyta severity	1% of plants with an open blossom, 2.5% Ascochyta severity	late vegetative growth, 3-5% of plants with 1+ Ascochyta lesions	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% incidence of plants with 1+ Ascochyta lesions	5% of plants with open blossom, 0.1% incidence of plants with 1+ Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	Five (10 to 14 days apart)	Four (10-13 days apart)	Five (12-14 days apart)	four (11-14 days apart)	Three (11-17 days apart)	Three (10-14 days apart)	Four (10-15 days apart)	Four (10-15 days apart)	Four (10-15 days apart)	Six (10-14 days apart)	
Nozzles:	DG110015 flat-fan, 35 psi	DG110015 flat-fan, 40 psi	XR11002 flat-fan, 30 psi	XR11002 flat-fan, 30 psi	XR11002 flat-fan, 30 psi	XR11002 flat-fan, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi	
Droplet size:	medium	fine	fine	fine	fine (1st applic), medium (2nd & 3rd application)	fine	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)	
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	April 22	April 29	April 25	May 7-8	April 28	May 16	May 18	May 18	May 18	Apr 23	
Disease assessments	June 16, June 27, July 16, Aug. 10	June 16, July 6, July 20, Aug. 15	June 18, July 22-23, Sept. 10	June 26; Jul 30-31; Aug 31-Sep 1	June 24, July 8-12, July 28-29	July 28-29, Aug. 5-8	Sept. 1-2	Aug. 2, Aug. 28-29	Sept. 1-2	July 26, Aug. 13, Aug. 27	
Harvest date	Sept. 5	Sept. 25	Oct. 7	Sept. 23-25	Aug. 18	Sept. 6	Sept. 20	Sept. 20	Sept. 20	Sept. 24	COMBINED ANALYSIS 10 studies
Plot length at harvest	ave. 20 ft	approx. 19 feet	ave. 24.0 ft	ave. 22.4 ft	ave. 19.0 ft	ave. 19.3 ft	ave. 17.9 ft	ave. 17.7 ft	ave. 17.9 ft	ave. 23.0	
Seeding rate	5.0 viable seeds/sq ft	4.0 viable seeds/sq ft	4.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	
Row spacing	7.0 inches	7.0 inches	7.5 inches	7.5 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches	7", 7 rows/plot	
	Ascochyta (0-100)										Ascochyta
Non-treated	**32** b	**56** b	**65** a	**69** b	**38** b	**13** b	**91** c	**34** b	**93** b	**63** c	**55** b
Proline 5.7 fl oz/ac	**3** a	**16** a	**22** a	**53** ab	**16** a	**2** a	**5** a	**10** a	**9** a	**16** a	**15** a
Miravis Neo 13.7 fl oz	**2** a	**14** a	**25** a	**50** a	**13** a	**12** ab	**42** b	**7** a	**23** a	**42** b	**23** a
CV:	42.2	13.6	27.3	19.1	34.4	38.3	31.7	21.6	29.1	12.3	19.4
	Yield (lbs/ac)										Yield
Non-treated	**1319** b	**2015** b	**336** b	**514** b	**1290** b	**2346** b	**1125** b	**1279** a	**1032** a	**6** b	**1126** b
Proline 5.7 fl oz/ac	**2424** a	**2891** a	**2291** a	**1931** a	**2484** a	**3651** a	**1892** a	**1443** a	**1831** a	**217** a	**2105** a
Miravis Neo 13.7 fl oz	**1883** ab	**3076** a	**1857** a	**1636** ab	**2314** a	**3027** ab	**1623** ab	**1653** a	**1852** a	**41** b	**1896** a
CV:	14.9	10.3	21.8	25.5	14.8	11.4	21.0	17.9	22.1		17.9

Improving the management of Ascochyta blight in chickpeas: Fungicide efficacy

The efficacy of Miravis Neo has been slipping, suggesting possible resistance development to the SDHI

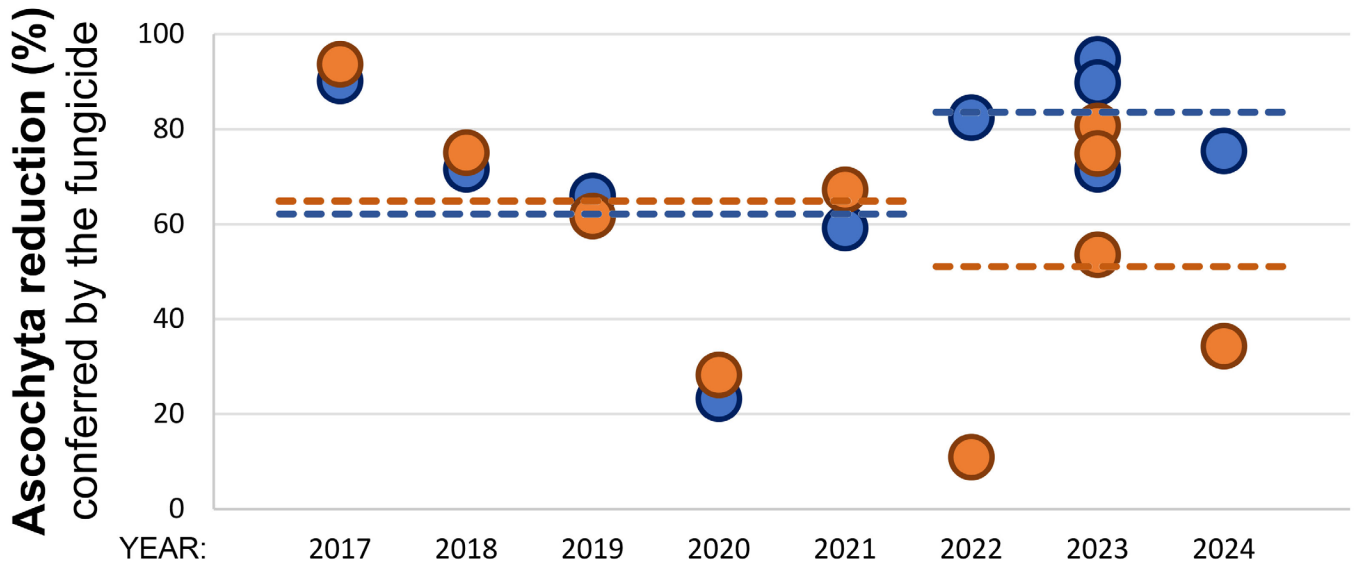
From 2017 to 2021, the Ascochyta management conferred by Proline and Miravis Neo was equivalent in field studies.

From 2022 to 2024, Proline conferred better Ascochyta management than Miravis Neo.

Miravis Neo = SDHI fungicide pydiflumetofen + two fungicides with little or efficacy against Ascochyta (azoxystrobin and propiconazole).

Miravis Neo relies on the SDHI pydiflumetofen for efficacy against Ascochyta.

Efficacy of Proline vs. Miravis Neo from 2017 to 2024



	2016 to 2021	2022 to 2024
Non-treated	**52** b	**59** b
Proline 5.7 fl oz	**22** a	**8** a
Miravis Neo 13.7 fl oz	**21** a	**25** b
	Ascochyta (0-100) 5 studies conducted from 2016 to 2021	**Ascochyta** (0-100) 5 studies conducted from 2022 to 2024

Proline: one study — average **Miravis Neo:** one study — average

Improving the management of Ascochyta blight in chickpeas: Fungicide efficacy

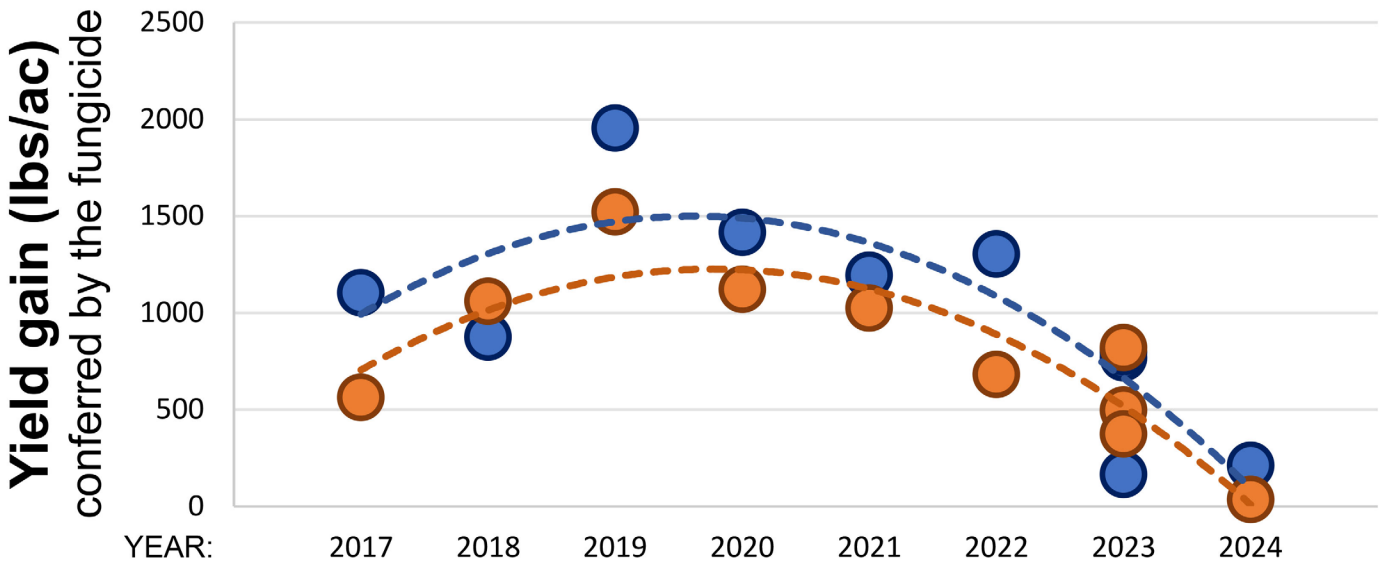
The efficacy of Miravis Neo has been slipping, suggesting possible resistance development to the SDHI

The erosion in Ascochyta disease control by Miravis Neo observed since 2022 has not yet translated into a complete loss in efficacy in field studies.

Miravis Neo = SDHI fungicide pydiflumetofen + two fungicides with little or efficacy against Ascochyta (azoxystrobin and propiconazole).

Miravis Neo relies on the SDHI pydiflumetofen for efficacy against Ascochyta.

Efficacy of Proline vs. Miravis Neo from 2017 to 2024



	2016 to 2021		2022 to 2024	
Non-treated	1095	b	1158	b
Proline 5.7 fl oz	2404	a	1807	a
Miravis Neo 13.7 fl oz	2153	a	1639	a
	Yield (lbs/ac) 5 studies conducted from 2016 to 2021		**Yield (lbs/ac)** 5 studies conducted from 2022 to 2024	

Proline: one study — average **Miravis Neo:** one study — average

Miravis Neo @ 13.7 fl oz/ac + **Bravo Weather Stik** @ 1.38 pt/ac

Miravis Top: FRAC group = 3, 7, 11 active ingredients = 0.63 lb/gal pydiflumetofen (FRAC 7), 0.83 lb/gal azoxystrobin (FRAC 11), 1.04 lb/gal propiconazole (FRAC 3)

Bravo WS: FRAC group = M5 active ingredient = chlorothalonil (6.0 lbs a.i./gal.)

Funding	Syngenta	Minor Use	NPGA and Harmonization Board	USDA Specialty Crop Block Grant	Minor Use	Harmonization Board	
Year	2019	2020	2021	2022	2023	2024	
Location	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington, ND	
Variety	CDC Leader	CDC Orion	CDC Orion	CDC Orion	CDC Leader	CDC Leader	
First application	late vegetative growth, 3-5% of plants with 1+ Ascochyta lesions	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% of plants with 1+ Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	Five (12-14 days apart)	Four (11-14 days apart)	Three (11-17 days apart)	Three (10-14 days apart)	Four (10-15 days apart)	Six (10-14 days apart)	
Nozzles:	XR11002 flat-fan, 30 psi	XR11002 flat-fan, 30 psi	XR11002 flat-fan, 30 psi	XR11002 flat-fan, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi (app 4, 5);	
Droplet size:	fine	fine	fine (1st applic), medium (2nd & 3rd application)	fine	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (app 1-3), med (app 4-5), med-coarse (app 6)	
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	April 25	May 7-8	April 28	May 16	May 18	Apr 23	
Disease assessments	June 18, July 22-23, Sept. 10	June 26; Jul 30-31; Aug 31-Sep 1	June 24, July 8-12, July 28-29	July 28-29, Aug. 5-8	Sept. 1-2	July 26, Aug. 13, Aug. 27	
Harvest date	Oct. 7	Sept. 23-25	Aug. 18	Sept. 6	Sept. 20	Sept. 24	COMBINED ANALYSIS 5 studies
Plot length at harvest	ave. 24.0 ft	ave. 22.4 ft	ave. 19.0 ft	ave. 19.3 ft	ave. 17.9 ft	ave. 23.0	
Seeding rate	4.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 pls/sq ft	
Row spacing	7.5 inches	7.5 inches	7.0 inches	7.0 inches	7.0 inches	7", 7 rows/plot	
	Ascochyta (0-100)						Ascochyta
Non-treated	**65** c	**69** c	**38** b	**13** b	**93** c	**63** d	**57** c
Proline 5.7 fl oz/ac	**22** b	**53** bc	**16** a	**2** a	**9** b	**16** b	**20** ab
Proline 5.7 fl oz **+ Bravo WS** 1.38 pt/ac	**2** a	**28** ab	**10** a	**3** ab	**0** a	**5** a	**8** a
Miravis Neo 13.7 fl oz	**25** b	**50** b	**13** a	**12** ab	**23** b	**42** c	**27** bc
Miravis Neo 13.7 fl oz + **Bravo WS** 1.38 pt	**2** a	**18** a	**11** a	**2** a	**1** a	**24** b	**10** a
CV:	27.3	19.1	34.4	38.3	29.1	12.3	24.2
	Yield (lbs/ac)						Yield
Non-treated	**336** b	**514** b	**1290** b	**2346** b	**1032** b	**6** b	**1104** c
Proline 5.7 fl oz/ac	**2291** a	**1931** a	**2484** a	**3651** a	**1831** ab	**217** a	**2438** ab
Proline 5.7 fl oz **+ Bravo WS** 1.38 pt/ac	**2253** a	**2870** a	**2577** a	**3709** ab	**2181** a	NO DATA	**2718** a
Miravis Neo 13.7 fl oz	**1857** a	**1636** ab	**2314** a	**3027** ab	**1852** ab	**41** ab	**2137** b
Miravis Neo 13.7 fl oz + **Bravo WS** 1.38 pt	**2523** a	**2205** a	**2731** a	**3460** a	**2113** a	NO DATA	**2606** ab
CV:	21.8	25.5	14.8	11.4	22.1		11.7

Miravis Top @ 13.7 fl oz/ac

FRAC group = 3, 7
active ingredients = pydiflumetofen (FRAC 7), difenoconazole (FRAC 3)
concentration = 0.63 lb pydiflumetofen + 1.04 lbs difenoconazole/gal

Funding	Syngenta	Syngenta	Syngenta	Harmonization Board & NPGA	Harmonization Board & NPGA	Corteva	Corteva	USDA Specialty Crop Block Grant	Harmonization Board	Syngenta	Harmonization Board
Year	2017	2018	2019	2019	2021	2021	2022	2022	2023	2023	2024
Location	Carrington	Carrington	Carrington	Hofflund, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND
Variety	CDC 'Frontier'	CDC 'Frontier'	'CDC Leader'	'CDC Frontier'	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Leader	CDC Leader	CDC Leader
First application	20% of plants with an open blossom, 2% Ascochyta severity	1% of plants with an open blossom, 2.5% Ascochyta severity	late vegetative growth, 3-5% of plants with 1+ Ascochyta lesions	bloom initiation, average 1.3% Ascochyta severity	bloom initiation, 0% Ascochyta	bloom initiation, 0% Ascochyta	5% of plants with open blossom, 5% of plants with 1+ Ascochyta lesions	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants in bloom, 0.1% of plants with ≥1 Ascochyta lesions	5% of plants in bloom, 0.1% of plants with ≥1 Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity
Number of applications	Five (10 to 14 days apart)	Four (10-13 days apart)	Five (12-14 days apart)	Three (13-15 days apart)	Three (11-17 days apart)	Three (13-16 days apart)	Three (10-14 days apart)	Three (10-14 days apart)	Four (10-15 days apart)	Four (10-15 days apart)	Six (10-14 days apart)
Nozzles:	DG110015 flat-fan, 35 psi	DG110015 flat-fan, 40 psi	XR11002, 30 psi	Wilger ER110-015 flat-fan, 40 psi	XR11002, 30 psi	XR11002, 30 psi (1st application); DG110015, 30 psi (apps #2, 3)	XR11002, 30 psi (applic 1, 2); DG110015, 40 psi (applic 3)	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015
Droplet size:	medium	fine	fine	fine	fine (1st applic), medium (2nd & 3rd application)	fine (1st applic), medium (2nd & 3rd application)	fine	fine	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac
Planting date	April 22	April 29	April 25	Apr. 24	April 28	April 28	May 16	May 16	May 18	May 18	Apr 23
Disease assessments	June 16, June 27, July 16, Aug. 10	June 16, July 6, July 20, Aug. 15	June 18, July 22-23, Sept. 10	June 25, July 11, Aug. 5	June 24, July 8-12, July 28-29	June 24, July 7, July 22	July 25, Aug. 4	July 28-29, Aug. 5-8	Sept. 1-2	Sept. 1-2	July 26, Aug. 13, Aug. 27
Harvest date	Sept. 5	Sept. 25	Oct. 7	Sept. 6	Aug. 18	Aug. 17	Sept. 6	Sept. 6	Sept. 20	Sept. 20	Sept. 24
Plot length at harvest	ave. 20 ft	approx. 19 feet	ave. 24.0 ft	ave. 20.5 ft	ave. 19.0 ft	ave. 20.0 ft	ave. 19.2 ft	ave. 19.3 ft	ave. 17.9 ft	ave. 17.5 ft	ave. 23.0
Seeding rate	5.0 viable seeds/sq ft	4.0 viable seeds/sq ft	4.0 viable seeds/sq ft	6.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft
Row spacing	7.0 inches	7.0 inches	7.5 inches	7.5 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches	7", 7 rows/plot
	Ascochyta (0-100)										COMBINED ANALYSIS 11 studies
											Ascochyta
Non-treated	**32** b	**56** b	**65** b	**21** c	**38** b	**23 b**	**17** b	**13** b	**93** b	**38** b	**63** c	**42** b
Proline 5.7 fl oz/ac	**3** a	**16** a	**22** a	**10** b	**16** a	**10 a**	**4** a	**2** a	**9** a	**6** a	**16** a	**10** a
Miravis Top 13.7 fl oz	**2** a	**15** a	**15** a	**4** a	**18** a	**11 a**	**5** a	**7** ab	**16** a	**6** a	**31** b	**12** a
CV:	42.2	13.6	27.3	24.1	34.4	30.6	69.6	38.3	29.1	23.2	12.3	15.0
	Yield (lbs/ac)											Yield
Non-treated	**1319** b	**2015** b	**336** b	**391** c	**1290** b	**1569** b	**750** a	**2346** b	**1032** b	**1057** b	**6** a	**1101** b
Proline 5.7 fl oz/ac	**2424** a	**2891** a	**2291** a	**1474** b	**2484** a	**2034** ab	**1400** a	**3651** a	**1831** ab	**1762** a	**217** b	**2042** a
Miravis Top 13.7 fl oz	**2030** a	**2838** a	**2051** a	**2438** a	**2147** a	**2302** a	**1508** a	**3347** ab	**2091** a	**1668** a	**57** ab	**2043** a
CV:	14.9	10.3	21.8	12.1	14.8	14.4	44.3	11.4	22.1	12.5		19.2

Miravis Top @ 13.7 fl oz/ac + **Bravo Weather Stik** @ 1.38 pt/ac

Miravis Top: FRAC group = 3, 7
active ingredients = 0.63 lb/gal pydiflumetofen (FRAC 7) + 1.04 lbs/gal difenoconazole (FRAC 3)

Bravo WS: FRAC group = M5
active ingredient = chlorothalonil (6.0 lbs a.i./gal.)

Funding	Syngenta	NPGA and Harmonization Board	NPGA and Harmonization Board	USDA Specialty Crop Block Grant	Harmonization Board	Syngenta	Harmonization Board	
Year	2019	2019	2021	2022	2023	2023	2024	
Location	Carrington	Hofflund, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	
Variety	CDC Leader	CDC Frontier	CDC Orion	CDC Orion	CDC Leader	CDC Leader	CDC Leader	
First application	late vegetative growth, 3-5% of plants with 1+ Ascochyta lesions	bloom initiation, average 1.3% Ascochyta severity	bloom initiation, 0% Ascochyta	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% of plants with 1+ Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	Five (12-14 days apart)	Three (13-15 days apart)	Three (11-17 days apart)	Three (10-14 days apart)	Four (10-15 days apart)	Four (10-15 days apart)	Six (10-14 days apart)	
Nozzles:	XR11002, 30 psi	Wilger ER110-015 flat-fan, 40 psi	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi (app 4, 5); AIXR1100015 50 psi (app 6)	
Droplet size:	fine	fine	fine (1st applic), medium (2nd & 3rd application)	fine	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)	
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	April 25	Apr. 24	April 28	May 16	May 18	May 18	Apr 23	
Disease assessments	June 18, July 22-23, Sept. 10	June 25, July 11, Aug. 5	June 24, July 8-12, July 28-29	July 28-29, Aug. 5-8	Sept. 1-2	Sept. 1-2	July 26, Aug. 13, Aug. 27	
Harvest date	Oct. 7	Sept. 6	Aug. 18	Sept. 6	Sept. 20	Sept. 20	Sept. 24	COMBINED ANALYSIS 7 studies
Plot length at harvest	ave. 24.0 ft	ave. 20.5 ft	ave. 19.0 ft	ave. 19.3 ft	ave. 17.9 ft	ave. 17.5 ft	ave. 23.0	
Seeding rate	4.0 viable seeds/sq ft	6.0 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 pls/sq ft	
Row spacing	7.5 inches	7.5 inches	7.0 inches	7.0 inches	7.0 inches	7.0 inches	7", 7 rows/plot	

	Ascochyta (0-100)							Ascochyta
Non-treated	**65** b	**21** c	**38** b	**13** b	**93** c	**38** b	**63** d	**47** c
Proline 5.7 fl oz/ac	**22** b	**10** b	**16** a	**2** a	**9** c	**6** a	**16** b	**11** ab
Proline 5.7 fl oz + **Bravo WS** 1.38 pt/ac	**2** a	**6** ab	**10** a	**3** ab	**0** a	**3** a	**5** a	**4** a
Miravis TOP 13.7 fl oz	**15** b	**4** a	**18** a	**7** ab	**16** b	**6** a	**31** c	**14** b
Miravis Top 13.7 fl oz + **Bravo WS** 1.38 pt	**1** a	**8** b	**12** a	**2** a	**0** a	**4** a	**19** b	**7** ab
CV:	27.3	24.1	34.4	38.3	29.1	23.2	12.3	27.3
	Yield (lbs/ac)							Yield
Non-treated	**336** b	**391** d	**1290** b	**2346** b	**1032** b	**1057** b	**6** b	**1075** b
Proline 5.7 fl oz/ac	**2291** a	**1474** c	**2484** a	**3651** a	**1831** ab	**1762** a	**217** a	**2249** a
Proline 5.7 fl oz + **Bravo WS** 1.38 pt/ac	**2253** a	**2564** a	**2577** a	**3709** ab	**2181** a	**1739** a	NO DATA	**2504** a
Miravis TOP 13.7 fl oz	**2051** a	**2438** ab	**2147** a	**3347** ab	**2091** a	**1668** a	**57** ab	**2290** a
Miravis Top 13.7 fl oz + **Bravo WS** 1.38 pt	**2226** a	**2069** b	**2274** a	**3456** a	**2036** a	**1683** a	NO DATA	**2291** a
CV:	21.8	12.1	14.8	11.4	22.1	12.5		11.7

Because of possible resistance problems developing with the SDHI pydimflumetofen, Miravis Top + Bravo WS – which contains a much more effective triazole fungicide than Miravis Neo – is a better choice than Miravis Neo for rotating with Proline + Bravo.

Applying Miravis Top + Bravo WS in a rotation with Proline + Bravo WS is best conducted when disease pressure is moderate. Under high disease pressure, Miravis Top + Bravo is less effective than Proline + Bravo.

Results from **Carrington (2024): very wet summer with very high Ascochyta pressure**

Six fungicide applications 10-14 days apart

Zorina 20 fl oz = premix of Provysol 5 fl oz + Endura 6 oz

	ASCOCHYTA 0 to 100	**YIELD** lbs/ac
Non-treated control	**67** d	**17** e
Proline 5.7 fl oz rotated with **Miravis Neo** 13.7 fl oz/ac	**34** c	**92** de
Proline 5.7 fl oz rotated with **Miravis Top** 13.7 fl oz/ac	**27** b	**222** de
Proline 5.7 fl oz rotated with **Zorina** 20 fl oz/ac	**21** b	**597** d
Proline 5.7 fl oz	**21** b	**477** de
Proline 5.7 fl oz + **Bravo WS** 1.38 pt rotated with **Miravis Neo** 13.7 fl oz + **Bravo WS** 1.38 pt/ac	**11** a	**1342** c
Proline 5.7 fl oz + **Bravo WS** 1.38 pt rotated with **Miravis Top** 13.7 fl oz + **Bravo WS** 1.38 pt/ac	**9** a	**1525** bc
Proline 5.7 fl oz + **Bravo WS** 1.38 pt rotated with **Zorina** 20 fl oz + **Bravo WS** 1.38 pt/ac	**6** a	**1986** ab
Proline 5.7 fl oz + **Bravo WS** 1.38 pt/ac	**5** a	**2216** a
CV:	15.8	30.9

Within-column means followed by different letters are significantly different ($P < 0.05$; Tukey multiple comparison procedure).

Omega @ 13.6 fl oz/ac

FRAC group = 29

active ingredient = fluazinam concentration = 4.17 lbs fluazinam/gal

Funding	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	NPGA and Harmonization Board	
Year	2012	2012	2013	2015	2015	2015	2015	2015	2015	
Location	Carrington	Hofflund	Hofflund	Sykeston	Sykeston	Sykeston	Sykeston	Sykeston	Sykeston	
Variety	CDC Frontier	CDC Frontier	CDC Frontier	CDC Alma	CDC Alma	CDC Frontier	CDC Frontier	Sierra	Sierra	
First application	1% plants in bloom; Ascochyta severity 0.25%	<10% plants in bloom, Ascochyta at trace levels	10% plants in bloom, Ascochyta at trace levels	bloom initiation, 2-5 Ascochyta lesions on most plants	bloom initiation, 2-5 Ascochyta lesions on most plants	bloom initiation, 2-5 Ascochyta lesions on most plants	bloom initiation, 2-5 Ascochyta lesions on most plants	bloom initiation, 10% Ascochyta severity	bloom initiation, 10% Ascochyta severity	
Number of applications	Three (11-13 days apart)	Four (10-13 days apart)	Three (13-17 days apart)	Three (13-14 days apart)	Three (13-14 days apart)	Three (13-14 days apart)	Three (13-14 days apart)	Three (13-14 days apart)	Three (13-14 days apart)	
Nozzles:	XR8001 flat-fan, 35 psi	XR8002 flat-fan, 40 psi	XR8002 flat-fan, 40 psi	TT11001 flat-fan, 40 psi	TT11001 flat-fan, 40 psi	TT11001 flat-fan, 40 psi	TT11001 flat-fan, 40 psi	TT11001 flat-fan, 40 psi	TT11001 flat-fan, 40 psi	
Droplet size:	fine	fine	fine	medium	medium	medium	medium	medium	medium	
Spray volume:	17.5 gal/ac	20 gal/ac	20 gal/ac	20 gal/ac	20 gal/ac	20 gal/ac	20 gal/ac	20 gal/ac	20 gal/ac	
Planting date	April 30	May 2	May 6	April 24-25	April 24-25	April 24-25	April 24-25	April 24-25	April 24-25	
Disease assessments	June 20, July 5, July 18	June 27, July 7, July 22	July 8, July 23, Aug. 12	June 30, July 11-12, July 27-28, Aug. 18-19	June 30, July 11-12, July 27-28, Aug. 18-19	June 30, July 11-12, July 27-28, Aug. 18-19	June 30, July 11-12, July 27-28, Aug. 18-19	June 30, July 11-12, July 27-28, Aug. 18-19	June 30, July 11-12, July 27-28, Aug. 18-19	
Harvest date	Aug. 13	Sept. 7	Sept. 16	Sept. 16	Sept. 16	Sept. 16	Sept. 16	Sept. 16	Sept. 16	COMBINED ANALYSIS 9 studies
Plot length (at harvest)	ave. 18.9 feet	ave. 14 ft	approx. 14 ft	ave. 25 ft	ave. 25 ft	ave. 25 ft	ave. 25 ft	ave. 25 ft	ave. 25 ft	
Seeding rate	4.5 pls/sq ft	4.5 pls/sq ft	4.5 pls/sq rt	4 pls/sq ft	4 pls/sq ft	4 pls/sq ft	4 pls/sq ft	4 pls/sq ft	4 pls/sq ft	
Row spacing	7 inches	7 inches	7.5 inches	7.5 inches	15 inches	7.5 inches	15 inches	7.5 inches	15 inches	
	Ascochyta (0-100)									Ascochyta
Non-treated	**5** a	**21** b	**28** b	**44** b	**49** b	**45** b	**49** b	**81** b	**81** b	**45** b
Proline 5.7 fl oz/ac	**2** a	**9** a	**5** a	**15** a	**11** a	**18** a	**11** a	**54** a	**57** a	**20** a
Omega 13.6 fl oz/ac	**2** a	**11** a	**13** ab	**15** a	**15** a	**15** a	**17** a	**75** b	**67** a	**26** a
CV:	62.2	32.3	29.9	34.7	16.9	23.8	21.0	8.7	10.1	24.2
	Yield (lbs/ac)									Yield
Non-treated	**3449** a	**1835** b	**1448** b	**1077** b	**1144** b	**1074** b	**1099** b	**0**	**0** b	**1236** b
Proline 5.7 fl oz/ac	**3709** a	**3055** a	**2381** a	**2500** a	**2529** a	**2536** a	**2585** a	**632**	**663** a	**2288** a
Omega 13.6 fl oz/ac	**3411** a	**2597** ab	**2203** a	**2323** a	**2545** a	**2326** a	**2326** a	**0**	**159** b	**1988** a
CV:	6.6	16.9	11.4	15.3	16.2	17.6	10.9		113.9	16.9

Priaxor @ 4 fl oz/ac

FRAC group = 7, 11
active ingredients = fluxapyroxad (FRAC 7), pyraclostrobin (FRAC 11)
concentration = 1.39 lbs fluxapyroxad + 2.78 lbs pyraclostrobin/gal

Funding:	NPGA and Harmonization Board	ADAMA	NPGA and Harmonization Board	USDA Specialty Crop Block Grant	Harmonization Board	Harmonization Board	
Year:	2020	2021	2021	2022	2023	2024	
Location:	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	
Variety:	'CDC Orion'	CDC Orion	CDC Orion	CDC Orion	CDC Leader	CDC Leader	
First application	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation, 0% Ascochyta	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants with open blossom, 0.1% incidence of plants with ≥1 Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	four (11-14 days apart)	Three (11-17 days apart)	Three (11-17 days apart)	Four (13-15 days apart)	Four (10-15 days apart)	Six (10-14 days apart)	
Nozzles:	XR11002, 30 psi	XR11002, 30 psi (1st applic.); DG110015, 30 psi (2nd, 3rd apps)	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30	
Droplet size:	fine	fine (1st app), medium (2nd & 3rd app)	fine (1st app), medium (2nd & 3rd app)	fine	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)	
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	May 7-8	April 28	April 28	May 16	May 18	Apr 23	
Disease assessments	June 26; July 30-31; Aug. 31-Sept. 1	June 24, July 7, July 22	June 24, July 8-12, July 28-29	July 28-29, Aug. 5-8	Sept. 1-2	July 26, Aug. 13, Aug. 27	
Harvest date	Sept. 23-25	Aug. 17	Aug. 18	Sept. 6	Sept. 20	Sept. 24	COMBINED ANALYSIS 6 studies
Plot length (at harvest)	ave. 22.4 ft	ave. 20.0 ft	ave. 19.0 ft	ave. 19.3 ft	ave. 17.9 ft	ave. 23.0	
Seeding rate	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 pls/sq ft	
Row spacing	7.5 inches	7 inches	7 inches	7 inches	7 inches	7", 7 rows/plot	
	Ascochyta (0-100)						Ascochyta
Non-treated	**69** a	**15** b	**38** b	**13** b	**93** b	**63** b	**49** b
Proline 5.7 fl oz/ac	**53** a	**6** a	**16** a	**2** a	**9** a	**16** a	**17** a
Priaxor 4 fl oz/ac	**67** a	**15** b	**34** b	**17** b	**91** b	**64** b	**48** b
CV:	19.1	32.5	34.4	38.3	29.1	12.3	44.1
	Yield (lbs/ac)						Yield
Non-treated	**514** b	**1540** a	**1290** b	**2346** b	**1032** a	**6** b	**1121** b
Proline 5.7 fl oz/ac	**1931** a	**2503** a	**2484** a	**3651** a	**1831** a	**217** a	**2103** a
Priaxor 4 fl oz/ac	**1189** ab	**2034** a	**1420** b	**2207** b	**1151** a	**10** b	**1335** b
CV:	25.5	17.6	14.8	11.4	22.1		18.6

Suspected fungicide resistance, Ascochyta blight of chickpeas: SDHI fungicide fluxapyroxad

Change in fungicide efficacy over time:

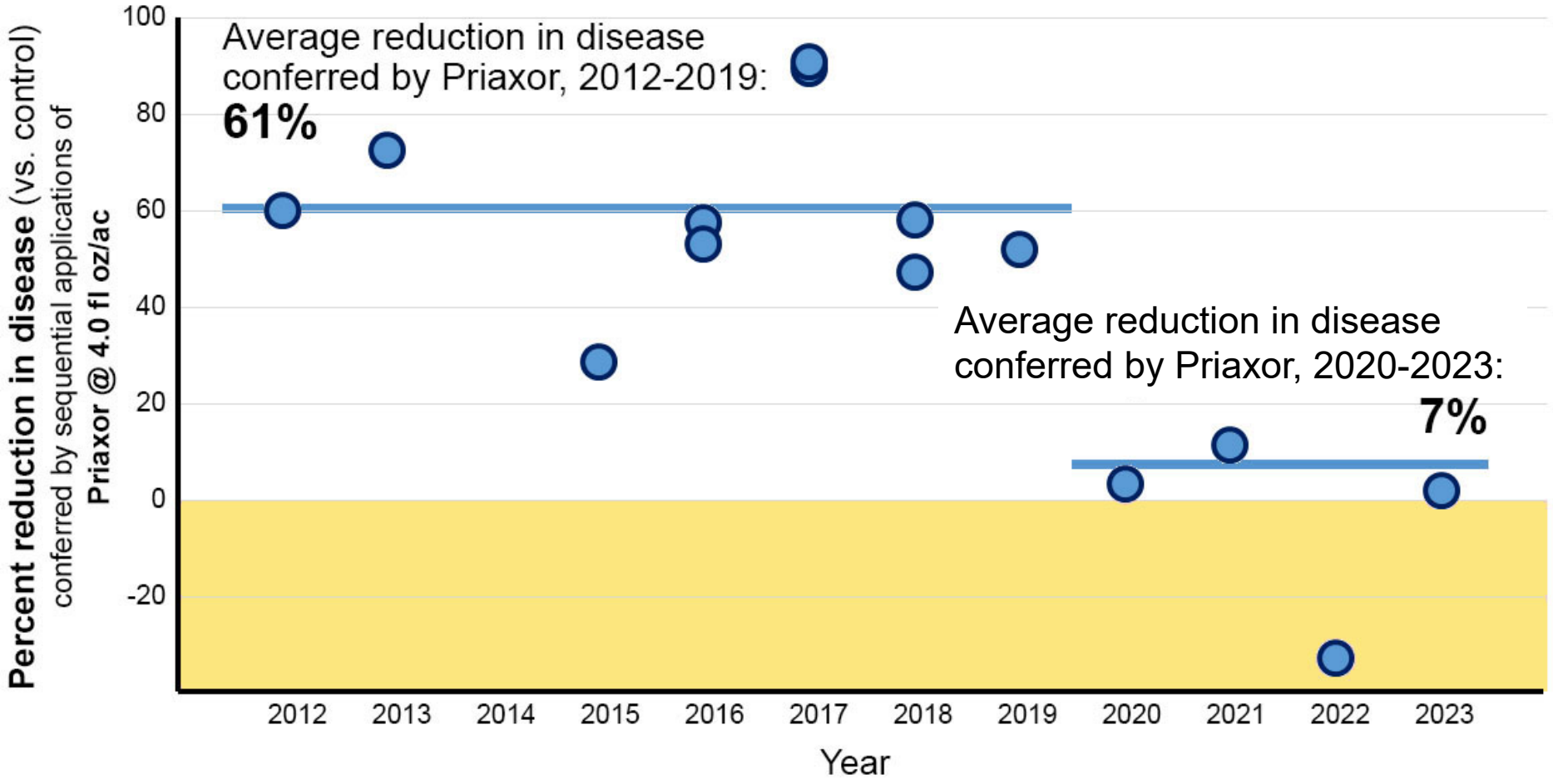
testing conducted in Carrington, ND from 2012-2023; same pattern observed in 2024

Three to six sequential applications of the same fungicide all season, with the number of applications dependent on rainfall patterns. Sequential applications of the same product are utilized in this type of testing in order to clearly characterize fungicide efficacy.

Priaxor (4.0 fl oz/ac) tested as sequential applications vs. a non-treated control

Priaxor = fluxapyroxad (FRAC 7) + pyraclostrobin (FRAC 11)

Due to pathogen resistance to QoI (FRAC 11) fungicides, Priaxor relies upon fluxapyroxad for efficacy against Ascochyta blight.



Suspected fungicide resistance, Ascochyta blight of chickpeas: SDHI fungicide fluxapyroxad

Change in fungicide efficacy over time:

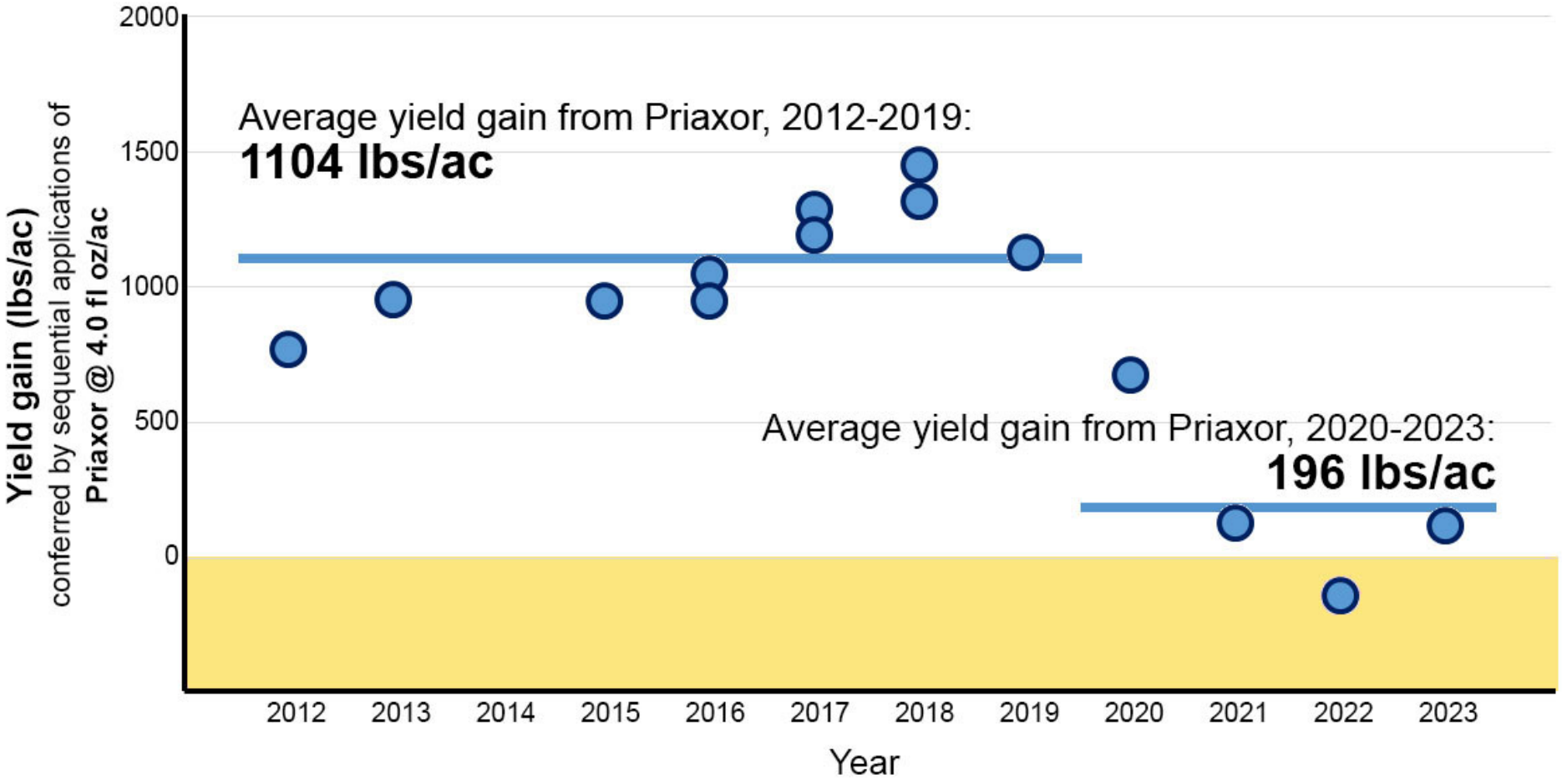
testing conducted in Carrington, ND from 2012-2023; same pattern observed in 2024

Three to six sequential applications of the same fungicide all season, with the number of applications dependent on rainfall patterns. Sequential applications of the same product are utilized in this type of testing in order to clearly characterize fungicide efficacy.

Priaxor (4.0 fl oz/ac) tested as sequential applications vs. a non-treated control

Priaxor = fluxapyroxad (FRAC 7) + pyraclostrobin (FRAC 11)

Due to pathogen resistance to QoI (FRAC 11) fungicides, Priaxor relies upon fluxapyroxad for efficacy against Ascochyta blight.



Provysol @ 3 fl oz/ac

FRAC group = 3

active ingredient = mefentrifluconazole concentration = 3.34 lbs mefentrifluconazole/gal

Funding	BASF	BASF	BASF	BASF	ADAMA	Harmonization Board & NPGA	BASF	USDA Specialty Crop Block Grant	Harmonization Board	Syngenta	Harmonization Board	
Year	2017	2018	2019	2020	2021	2021	2021	2022	2023	2023	2024	
Location	Carrington	Carrington	Carrington	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	
Variety	CDC 'Frontier'	CDC 'Frontier'	'CDC Frontier'	'CDC Orion'	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Leader	CDC Leader	CDC Leader	
First application	20% of plants with an open blossom, 2% Ascochyta severity	1% of plants with an open blossom, 2.5% Ascochyta severity	late vegetative growth, 3-5% of plants with ≥1 Ascochyta lesions	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation, 0% Ascochyta	5% of plants with open blossom, 5% of plants with ≥1 Ascochyta lesions	5% of plants in bloom, 0.1% incidence of plants with ≥1 Ascochyta lesions	5% of plants in bloom, 0.1% incidence of plants with ≥1 Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	Five (10 to 14 days apart)	Four (10-13 days apart)	Five (11-14 days apart)	four (11-14 days apart)	Three (11-17 days apart)	Three (11-17 days apart)	Three (11-17 days apart)	Four (13-15 days apart)	Four (10-15 days apart)	Four (10-15 days apart)	Six (10-14 days apart)	
Nozzles:	DG110015 flat-fan, 35 psi	DG110015 flat-fan, 40 psi	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi (1st applic.); DG110015, 30 psi (2nd, 3rd apps)	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi (app 4, 5); AIXR1100015 50 psi (app 6)	
Droplet size:	medium	medium	fine	fine	fine (1st app), medium (2nd & 3rd app)	fine (1st app), medium (2nd & 3rd app)	fine (1st app), medium (2nd & 3rd app)	fine	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)	
Spray volume:	15	15	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	April 22	April 29	April 25	May 7-8	April 28	April 28	April 28	May 16	May 18	May 18	Apr 23	
Disease assessments	June 16, June 27, July 16, Aug. 10	June 16, July 20, Aug. 14	June 19, July 22, Aug. 22-24	June 26; July 30-31; Aug. 31-Sept. 1	June 24, July 7, July 22	June 24, July 8-12, July 28-29	June 24, July 5, July 23	July 28-29, Aug. 5-8	Sept. 1-2	Sept. 1-2	July 26, Aug. 13, Aug. 27	
Harvest date	Sept. 5	Sept. 25	Oct. 7	Sept. 23-25	Aug. 17	Aug. 18	Aug. 17	Sept. 6	Sept. 20	Sept. 20	Sept. 24	COMBINED ANALYSIS 11 studies
Plot length at harvest	average 20 ft	approx. 19 feet	ave. 23.8 ft	ave. 22.4 ft	ave. 20.0 ft	ave. 19.0 ft	ave. 19.7 ft	ave. 19.3 ft	ave. 17.9 ft	ave. 17.5 ft	ave. 23.0	
Seeding rate	5 viable seeds/sq ft	4 viable seeds/sq ft	4 viable seeds/sq ft	4.5 viable seed/sq ft	4.5 viable seed/sq ft	4.5 viable seed/sq ft	4.5 viable seed/sq ft	4.5 viable seed/sq ft	4.5 viable seed/sq ft	4.5 viable seed/sq ft	4.5 pls/sq ft	
Row spacing	7 inches	7 inches	7.5 inches	7.5 inches	7 inches	7 inches	7 inches	7 inches	7 inches	7 inches	7", 7 rows/plot	
	Ascochyta (0-100)											Ascochyta
Non-treated	**33** b	**55** b	**60** b	**69** b	**15** b	**38** b	**25** b	**13** b	**93** b	**38** b	**63** b	**46** b
Proline 5.7 fl oz/ac	**5** a	**26** a	**8** a	**43** a	**6** a	**16** a	**9** a	**2** a	**9** a	**6** a	**16** a	**13** a
Provysol 3 fl oz/ac	**2** a	**22** a	**9** a	**40** a	**9** ab	**19** a	**13** a	**5** ab	**9** a	**7** a	**22** a	**14** a
CV:	19.4	22.0	19.9	21.7	32.5	34.4	28.9	38.3	29.1	23.2	12.3	52.5
	Yield (lbs/ac)											Yield
Non-treated	**1342** b	**1670** b	**24** b	**514** b	**1540** a	**1290** b	**1123** a*	**2346** b	**1032** a	**1057** b	**6** b	**1086** b
Proline 5.7 fl oz/ac	**2123** a	**3171** a	**1089** a	**2134** a	**2503** a	**2484** a	**1912** a	**3651** a	**1831** a	**1762** a	**217** a	**2080** a
Provysol 3 fl oz/ac	**2410** a	**2954** a	**915** a	**1535** a	**2070** a	**2088** a	**1710** a	**3489** ab	**1697** a	**1590** a	**130** a	**1872** a
CV:	10.0	6.6	51.7	20.2	17.6	14.8	25.4	11.4	22.1	12.5		13.9

Provysol @ 5 fl oz/ac

FRAC group = 3

active ingredient = mefentrifluconazole concentration = 3.34 lbs mefentrifluconazole/gal

Funding	BASF	BASF	BASF	BASF	BASF	BASF	Harmonization Board	Harmonization Board	
Year	2015	2016	2017	2018	2019	2020	2023	2024	
Location	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington, ND	Carrington, ND	Carrington, ND	
Variety	CDC 'Alma'	CDC 'Orion'	CDC 'Frontier'	CDC 'Frontier'	'CDC Frontier'	'CDC Orion'	CDC Leader	CDC Leader	
First application	late vegetative growth, 0.1% Ascochyta severity	70% of plants with an open blossom, 0.5% Ascochyta severity	20% of plants with an open blossom, 2% Ascochyta severity	1% of plants with an open blossom, 2.5% Ascochyta severity	late vegetative growth, 3-5% of plants with ≥1 Ascochyta lesion	90% of plants with open blossom; trace levels of Ascochyta	5% of plants with open blossom, 0.1% plants with ≥1 Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	Four (12 to 15 days apart)	Six (12-15 days apart)	Five (10 to 14 days apart)	Four (10-13 days apart)	Five (11-14 days apart)	four (11-14 days apart)	Four (10-15 days apart)	Six (10-14 days apart)	
Nozzles:	XR80015 flat-fan, 40 psi	XR80015 flat-fan, 35 psi	DG110015 flat-fan, 35 psi	DG110015 flat-fan, 40 psi	XR11002, 30 psi	XR11002 flat-fan nozzles, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi (app 4, 5); AIXR1100015 50 psi (app 6)	
Droplet size:	fine	fine	medium	medium	fine	fine	fine (applic. 1, 2); medium (applic. 3,4)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)	
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	April 23	April 22	April 22	April 29	April 25	May 7-8	May 18	Apr 23	
Disease assessments	June 25, July 27, Aug. 25	June 9; July 20 & 29; Aug. 4, 16, and 30	June 16, June 27, July 16, Aug. 10	June 16, July 20, Aug. 14	June 19, July 22, Aug. 22-24	June 26; July 30-31; August 31-Sept. 1	Sept. 1-2	July 26, Aug. 13, Aug. 27	
Harvest date	Sept. 29	Sept. 14	Sept. 5	Sept. 25	Oct. 7	Sept. 23-25	Sept. 20	Sept. 24	COMBINED ANALYSIS 8 studies
Plot length (at harvest)	average 19 ft	average 19 ft	average 20 ft	approx. 19 feet	ave. 23.8 ft	ave. 22.4 ft	ave. 17.9 ft	ave. 23.0	
Seeding rate	4.0 pls/sq ft	4.0 pls/sq ft	5.0 pls/sq ft	4.0 pls/sq ft	4.0 pls/sq ft	4.5 pls/sq ft	4.5 pls/sq ft	4.5 pls/sq ft	
	Ascochyta (0-100)								Ascochyta
Non-treated	**67** b	**71** b	**33** b	**55** b	**60** b	**69** b	**93** bc	**63** b	**64** b
Proline 5.7 fl oz/ac	**18** a	**22** a	**5** a	**26** a	**8** a	**43** a	**9** a	**16** a	**19** a
Provysol 5.0 fl oz/ac	**17** a	**15** a	**3** a	**21** a	**6** a	**49** a	**8** a	**16** a	**17** a
CV:	18.4	9.6	19.4	22.0	19.9	21.7	29.1	12.3	34.2
	Yield (lbs/ac)								Yield
Non-treated	**12** c	**197** c	**1342** b	**1670** b	**24** b	**514** b	**1032** a	**6** b	**684** b
Proline 5.7 fl oz/ac	**1490** b	**1275** b	**2123** a	**3171** a	**1089** a	**2134** a	**1831** a	**217** a	**1873** a
Provysol 5.0 fl oz/ac	**2033** a	**1751** a	**2489** a	**3236** a	**1295** a	**2150** a	**1741** a	**325** a	**2099** a
CV:	14	11.2	10.0	6.6	51.7	20.2	22.1		22.4

Provysol, 3 fl oz vs. 5 fl oz/ac

FRAC group = 3 active ingredient = mefentrifluconazole concentration = 3.34 lbs mefentrifluconazole/gal

Funding	BASF	BASF	BASF	BASF	Minor Use	Minor Use	
Year	2017	2018	2019	2020	2023	2024	
Location	Carrington	Carrington	Carrington	Carrington, ND	Carrington, ND	Carrington, ND	
Variety	CDC 'Frontier'	CDC 'Frontier'	'CDC Frontier'	'CDC Orion'	CDC Leader	CDC Leader	
First application	20% of plants with an open blossom, 2% Ascochyta severity	1% of plants with an open blossom, 2.5% Ascochyta severity	14-16 nodes, no blossoms, 3-5% of plants with Ascochyta, <0.5% severity	90% plants with open blossom; trace levels of Ascochyta	bloom initiation (5% of plants in bloom), 0.1% of plants with Ascochyta	late vegetative growth, 1-2% Ascochyta severity	
Number of applications	Five (10 to 14 days apart)	Four (10-13 days apart)	Five (11-14 days apart)	four (11-14 days apart)	Four (10-14 days apart)	Six (10-14 days apart)	
Nozzles:	DGXR110015 flat-fan nozzles, 35 psi	DGXR110015 flat-fan, 40 psi	XR11002, 30 psi	XR11002 flat-fan nozzles, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi (app 4, 5); AIXR1100015 50 psi (app 6)	
Droplet size:	medium	medium	fine	fine	fine, medium	fine (app 1-3), medium (app 4-5), med-coarse (app 6)	
Spray volume:	15	15	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
Planting date	April 22	April 29	April 25	May 7-8	May 18	Apr 23	
Disease assessments	June 16, June 27, July 16, Aug. 10	June 16, July 20, Aug. 14	June 19, July 22, Aug. 22-24	June 26; July 30-31; August 31-Sept. 1	Sept. 1-2	July 26, Aug. 13, Aug. 27	
Harvest date	Sept. 5	Sept. 25	Oct. 7	Sept. 23-25	Sept. 20	Sept. 24	COMBINED ANALYSIS 6 studies
Plot length (at harvest)	average 20 ft	approx. 19 feet	ave. 23.8 ft	ave. 22.4 ft	ave. 17.9	ave. 23.0	
Seeding rate	5 pls/sq ft	4 pls/sq ft	4 pls/sq ft	4.5 pls/sq ft	4.5 pls/sq ft	4.5 pls/sq ft	
Row spacing	7 inches, 7 rows/plot	7 inches, 7 rows/plot	7.5 inches	7.5 inches, 7 rows/plot	7", 7 rows/plot	7", 7 rows/plot	
	Ascochyta (0-100)						Ascochyta
Non-treated	**33** b	**55** b	**60** b	**69** b	**93** b	**63** b	**62** b
Proline 5.7 fl oz/ac	**5** a	**26** a	**8** a	**43** a	**9** a	**16** a	**18** a
Provysol 3 fl oz/ac	**2** a	**22.48** a	**9** a	**40** a	**9** a	**22** a	**17** a
Provysol 5 fl oz/ac	**3** a	**21** a	**6** a	**49** ab	**8** a	**16** a	**17** a
CV:	19.4	22.0	19.9	21.7	29.1	12.3	39.4
	Yield (lbs/ac)						Yield
Non-treated	**1342** b	**1670** b	**24** b	**514** b	**1032** a	**6** b	**765** b
Proline 5.7 fl oz/ac	**2123** a	**3171** a	**1089** ab	**2134** a	**1831** a	**217** a	**1761** a
Provysol 3 fl oz/ac	**2410** a	**2954** a	**915** ab	**1535** a	**1697** a	**130** a	**1607** a
Provysol 5 fl oz/ac	**2489** a	**3236** a	**1295** a	**2150** a	**1741** a	**325** a	**1873** a
CV:	10.0	6.6	51.7	20.2	22.1		17.7

Provysol @ 3 fl oz/ac + **Bravo Weather Stik** @ 1.38 pt/ac

Provysol: FRAC group = 3
active ingredient = mefentrifluconazole (3.34 lbs a.i./gal.)

Bravo WS: FRAC group = M5
active ingredient = chlorothalonil (6.0 lbs a.i./gal.)

Funding:		BASF	Harmonization Board & NPGA	BASF	ADAMA	Harmonization Board & NPGA	BASF	USDA Specialty Crop Block Grant	Harmonization Board	Harmonization Board
Year:		2019	2020	2020	2021	2021	2021	2022	2023	2024
Location:		Carrington	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND
Variety:		CDC Frontier	'CDC Orion'	'CDC Orion'	CDC Orion	CDC Orion	CDC Orion	CDC Orion	CDC Leader	CDC Leader
First application		late vegetative growth, 3-5% of plants with ≥1 Ascochyta lesions	90% of plants with open blossom; trace levels of Ascochyta	90% of plants with open blossom; trace levels of Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation, 0% Ascochyta	bloom initiation, 0% Ascochyta	5% of plants in bloom, 5% of plants with ≥1 Ascochyta lesions	5% of plants in bloom, 0.1% of plants with ≥1 Ascochyta lesions	late vegetative growth, 1-2% Ascochyta severity
Number of applications		Five (11-14 days apart)	four (11-14 days apart)	four (11-14 days apart)	Three (11-17 days apart)	Three (11-17 days apart)	Three (11-17 days apart)	Four (13-15 days apart)	Four (10-15 days apart)	Six (10-14 days apart)
Nozzles:		XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi (1st applic.); DG110015, 30 psi (2nd, 3rd apps)	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)	DG11005 40 psi (app 1, 2); XR11002, 30 psi (app 3); DG110015 30 psi
Droplet size:		fine	fine	fine	fine (1st app), medium (2nd & 3rd app)	fine (1st app), medium (2nd & 3rd app)	fine (1st app), medium (2nd & 3rd app)	fine	fine (1st, 2nd applic.); medium (3rd & 4th app)	fine (app 1-3), medium (app 4-5), med-coarse (app 6)
Spray volume:		15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac
Planting date		April 25	May 7-8	May 7-8	April 28	April 28	April 28	May 16	May 18	Apr 23
Disease assessments		June 19, July 22, Aug. 22-24	June 26; Jul 30-31; Aug 31-Sept 1	June 26; Jul 30-31; Aug 31-Sept 1	June 24, July 7, July 22	June 24, July 8-12, July 28-29	June 24, July 5, July 23	July 28-29, Aug. 5-8	Sept. 1-2	July 26, Aug. 13, Aug. 27
Harvest date		Oct. 7	Sept. 23-25	Sept. 23-25	Aug. 17	Aug. 18	Aug. 17	Sept. 6	Sept. 20	Sept. 24
Plot length (at harvest)		ave. 23.8 ft	ave. 22.4 ft	ave. 22.4 ft	ave. 20.0 ft	ave. 19.0 ft	ave. 19.7 ft	ave. 19.3 ft	ave. 17.9 ft	ave. 23.0
Seeding rate		4 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft	4.5 viable seeds/sq ft
Row spacing		7.5 inches	7.5 inches	7.5 inches	7 inches	7 inches	7 inches	7 inches	7 inches	7 inches
		Ascochyta (0-100)								
Non-treated control		**60** c	**73** c	**69** b	**15** b	**38** b	**25** b	**13** b	**93** c	**63** b
Provysol 3 fl oz/ac		**9** b	**39** b	**40** a	**9** ab	**19** a	**13** a	**5** ab	**9** b	**22** a
Provysol 3 fl oz + **Bravo WS** 1.38 pt		**3** a	**20** a	**24** a	**6** a	**13** a	**9** a	**3** a	**3** a	**14** a
	CV:	19.9	15.9	21.7	32.5	34.4	28.9	38.3	29.1	12.3
		Yield (lbs/ac)								
Non-treated control		**24** b	**202** b	**514** c	**1540** b	**1290** b	**1123** a	**2346** b	**1032** b	**6** b
Provysol 3 fl oz/ac		**915** a	**2824** a	**1535** b	**2070** ab	**2088** a	**1710** a	**3489** ab	**1697** ab	**130** a
Provysol 3 fl oz + **Bravo WS** 1.38 pt		**1896** a	**2727** a	**2831** a	**2580** a	**2520** a	**1261** a	**3580** a	**2296** a	NO DATA
	CV:	51.7	31.3	20.2	17.6	14.8	25.4	11.4	22.1	

COMBINED ANALYSIS 9 studies
Ascochyta
50 b
18 a
11 a
17.9
Yield
1009 b
2041 a
2461 a
26.0

Revytek, 8 fl oz

Provysol @ 3 fl oz contains 35.2 g mefentrifluconazole
Revytek @ 8 fl oz contains 31.3 g mefentrifluconazole

Provysol	mefentrifluconazole, 400 g a.i./liter
Revytek	mefentrifluconazole, 133.3 g a.i./literl; pyraclostrobin, 177.7 g a.i./liter; fluxapyroxad, 88.9 g a.i./liter

Funding:	NPGA/BioSafe	BASF/Nichino	ND Dept Ag / USDA	ND Harmonization Board
Year	2021	2021	2022	2023
Location	Carrington, ND	Carrington, ND	Carrington, ND	Carrington, ND
Variety	CDC Orion	CDC Orion	CDC Orion	CDC Leader
First application	Ascochyta	Ascochyta	plants with open blossom,	plants with open blossom,
Number of applications	Three	Three	Three	Four
Nozzles:	XR11002 @ 30 psi (1st applic., canopy open), DG110015 @ 30 psi (2nd, 3rd apps, canopy at/near closure)	XR11002 @ 30 psi (1st applic., canopy open), DG110015 @ 30 psi (2nd, 3rd apps, canopy at/near closure)	XR11002, 30 psi (applic 1, 2); DG110015, 40 psi (applic 3)	XR11002, 30 psi (applic 1, 2); DG110015, 30 psi (applic 3, 4)
Droplet size:	fine (1st app), medium (2nd & 3rd app)	fine (1st app), medium (2nd & 3rd app)	fine	fine, medium
Spray volume:	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac
Planting date	April 28	April 28	May 16	May 18
Disease assessments	June 24, July 8-12, July 28-2	June 24, July 5, July 23	July 28-29, Aug. 5-8	Sept. 1-2
Harvest date	Aug. 18	Aug. 17	Sept. 6	Sept. 20
Plot length (at harvest)	ave. 19.0 ft	ave. 19.7 ft	ave. 19.3	ave. 17.9
Seeding rate	4.5 viable seeds/sq ft = 196,020 viable seeds/ac	4.5 viable seeds/sq ft = 196,020 viable seeds/ac	4.5 viable seeds/sq ft = 196,020 viable seeds/ac	4.5 viable seeds/sq ft = 196,020 viable seeds/ac
Row spacing	7", 7 rows/plot	7", 7 rows/plot	7", 7 rows/plot	7", 7 rows/plot

COMBINED ANALYSIS

4 studies

	Ascochyta (0-100)				Ascochyta
Non-treated	**38** b	**25** b	**13** b	**93** b	**42** b
Proline 5.7 fl oz/ac	**16** a	**9** a	**2** a	**9** a	**9** a
Revytek 8 fl oz/ac	**13** a	**9** a	**7** ab	**10** a	**10** a
Provysol 3 fl oz/ac	**19** a	**13** a	**5** ab	**9** a	**11** a
CV:	19.1	32.5	34.4	38.3	17.0
	Yield (lbs/ac)				Yield
Non-treated	**1290** b	**1123** a	**2346** b	**1032** b	**1448** b
Proline 5.7 fl oz/ac	**2484** a	**1912** a	**3651** a	**1831** ab	**2470** a
Revytek 8 fl oz/ac	**2220** a	**1491** a	**3385** ab	**1965** a	**2265** a
Provysol 3 fl oz/ac	**2088** a	**1710** a	**3489** ab	**1697** ab	**2246** a
CV:	25.5	17.6	14.8	11.4	8.0