

EVALUATION OF FUNGICIDES FOR THEIR EFFICACY AGAINST PHOMOPSIS STEM CANKER OF SUNFLOWER USING REMOTE SENSING TECHNOLOGY



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OUTLINE

- Introduction
 - Phomopsis stem canker
 - Remote sensing technology
- Research
 - Objective
 - Experiment
 - Results
 - Summary
 - Future work



PHOMOPSIS STEM CANKER



Leaf symptoms of Phomopsis stem canker
(Mathew et al. 2020; “*The Sunflower*”)

- An economically important disease of sunflower
- Yield losses of 40%; Oil reduced by 10-15% (Mathew et al 2015)
- Caused by several species of *Diaporthe*
 - *D. helianthi* and *D. gulyae* are predominant in the U.S.



PHOMOPSIS STEM CANKER



Stem lesion of Phomopsis stem canker
(Mathew et al. 2020; “*The sunflower*”)

Phomopsis stem canker →

Phoma black stem →



Phomopsis stem canker can be
confused with other diseases
(Mathew et al. 2020; “*The sunflower*”)



FUNGICIDES

- Foliar fungicides labeled on sunflower include-
 - Triazole (FRAC 3)
 - QoI (FRAC 11)
 - SDHI (FRAC 7)

- Efficacy against Phomopsis stem canker



FUNGICIDES

- Traditional fungicides evaluation
 - Visible symptoms caused by pathogen
- Remote sensing technology
 - Provide repetitive observations of the same object with a larger spectral range than the human eye
- Normalized Difference Vegetation Index (NDVI)
 - GreenSeeker
 - Multispectral sensor (Unmanned Aerial Vehicle / Drones)



NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI)

- NDVI uses a combination of visual red light and near-infrared light
- NDVI measures plant health based on how a plant reflects light at specific frequencies.
- Plant pathogens modify the radiative properties of the crop canopy



RESEARCH OBJECTIVE

- Compare the efficacy of the fungicides against Phomopsis stem canker at R1 growth stage using remote sensing technology



Terminal bud forms a miniature floral head rather than a cluster of leaves (Schneiter and Miller 1981)



EXPERIMENT



- Felt Farm, Brookings SD
- Planted on June 2nd
- Susceptible oil type hybrid (Nuseed)
- Randomized complete block design
- Plot size: 4 rows spaced at 30 inches, 20 feet in length
- Seeding rate: 18,000 seeds/A



EXPERIMENT

	Treatments	Frac code	Rate oz/A
1	Non treated control	-	-
2	Headline	11	6
3	Priaxor (pre-mix)	7+11	4
4	Miravis NEO (pre-mix)	3+7+11	13.7
5	Trivapro (pre-mix)	3+7+11	13.7
6	Aproach Prima (pre-mix)	3+11	6.8
7	Endura	7	9
8	Folicur 430F	3	4
9	Headline + Folicur 430F (tank-mix)	11+3	6+4
10	Headline + Endura (tank-mix)	11+7	6+9
11	Endura + Folicur 430F (tank-mix)	7+3	9+4

- 10 treatments and non-treated control, 4 replications per treatment
- Fungicides rates applied according to the label
- All fungicides were applied with adjuvant (Induce; 0.125% V/V)



EXPERIMENT



- Application at R1 growth stage (07/21)
- All four rows sprayed
- Spray pressure: 30 psi
- Nozzle: flat fan (XR8002)
- Spray volume: 30 gal/A
- Speed: 2 mph



DISEASE EVALUATION

- Disease severity was evaluated at R7-R8 using scale 0 to 5 on (Mathew et al. 2015)
- A total of 10 random plants in the two middle rows
- Plots were harvested on 10/14



R7- the back of the head has started to turn pale yellow (Schneiter and Miller 1981)



R8- the back of the head is yellow but the bracts remain green (Schneiter and Miller 1981)



NDVI EVALUATION USING GREENSEEKER

- Normalized difference vegetation index (NDVI) values collected from the two middle rows using GreenSeeker® handheld sensor (Trimble Navigation Limited, Westminster, CO)
- First reading (07/21), before fungicides application; Second reading (07/30), after fungicides application
- Third reading (09/23), same day as disease severity evaluation



NDVI EVALUATION USING MULTISPECTRAL SENSOR

- Drone – Phantom 4 Pro V2.0
- Sensor - multispectral (5-band Red Edge)
- NDVI values obtained using ArcGIS (V10.7.1)

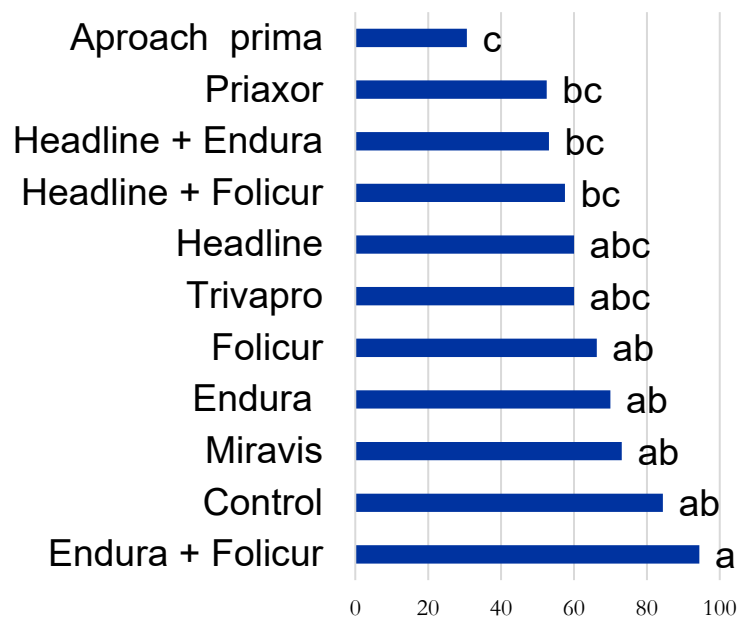


DATA ANALYSES

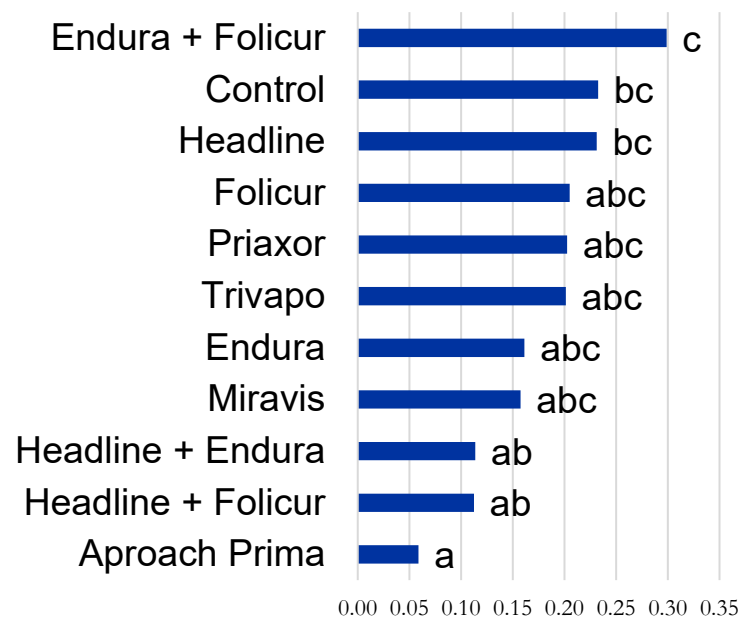
- Disease severity index (DSI), NDVI, and yield data analyzed in R
- Treatment means comparison using Fisher's LSD test ($\alpha=0.05$)
- Pearson's correlations were performed between DSI and NDVI, DSI and yield, NDVI and yield



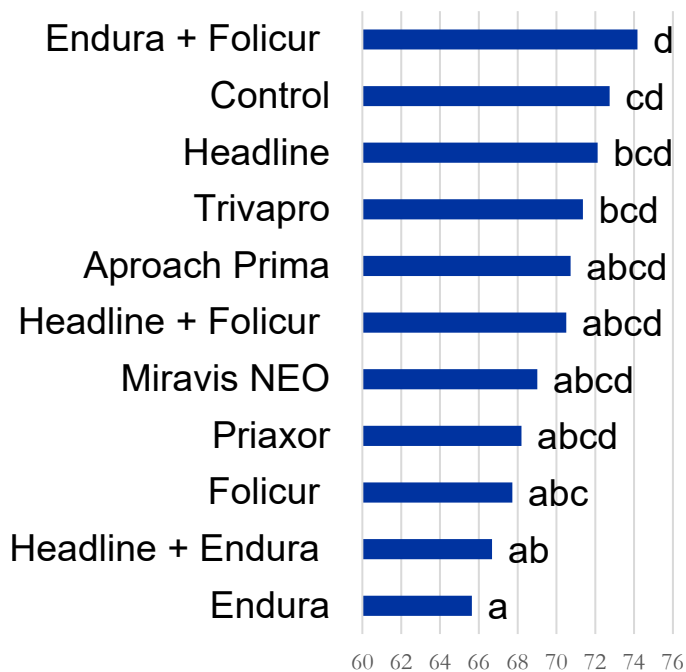
**DSI values collected on 9/23
using scale 0 to 5 (Mathew et al. 2015)**



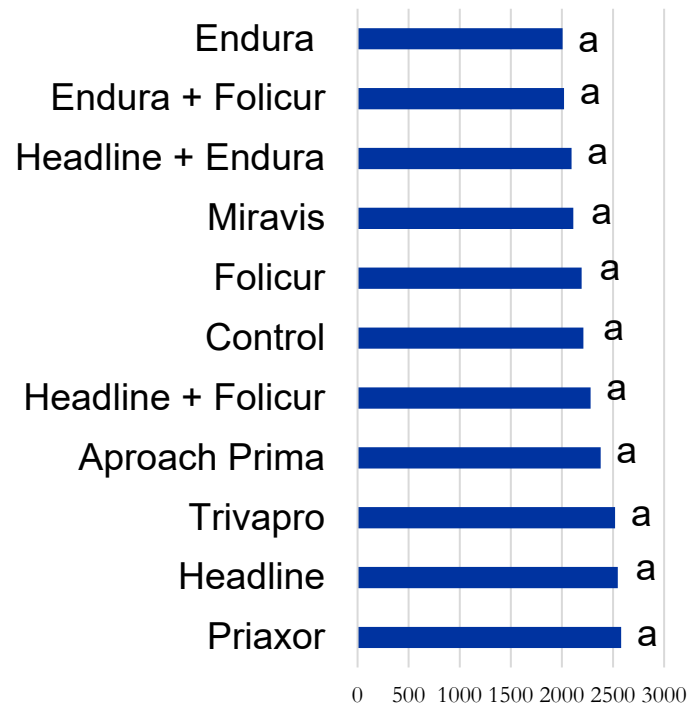
**NDVI values from the third reading
collected on 9/23 using GreenSeeker**



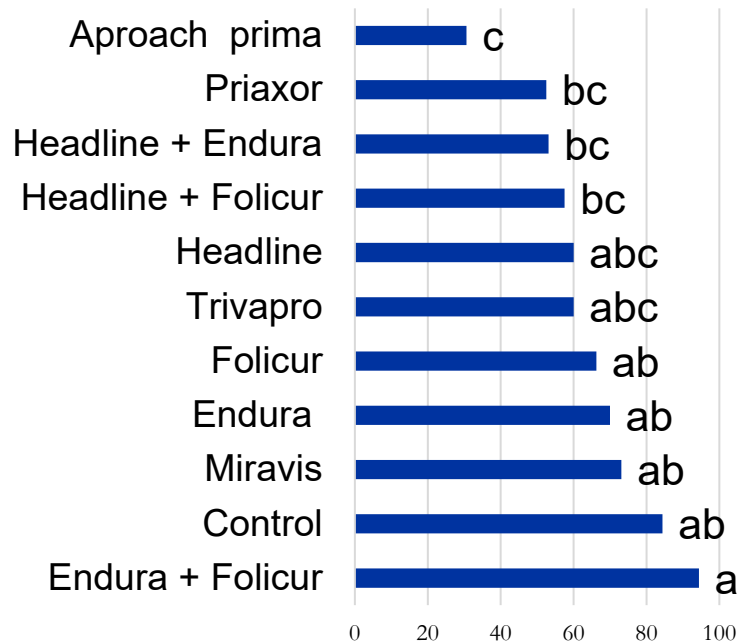
**NDVI values collected on 8/17
using UAV Drone**



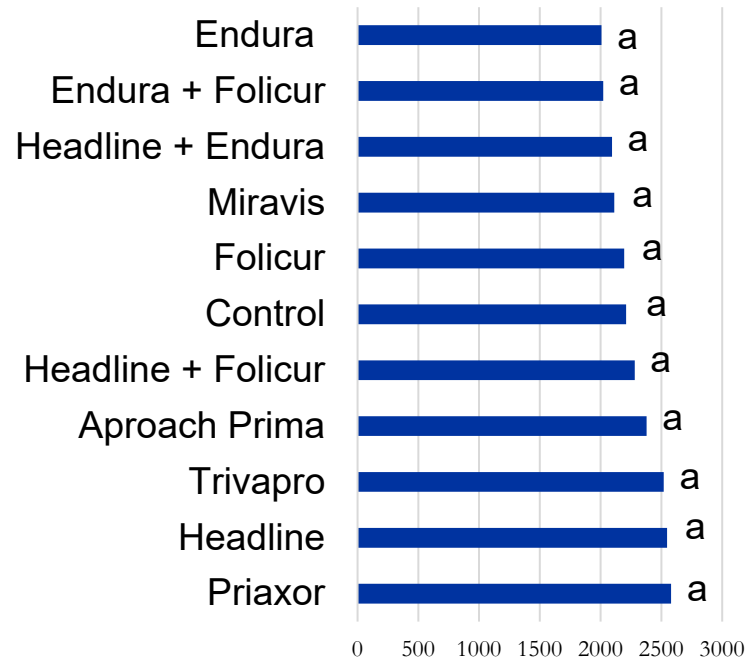
**Sunflower yield (lb/A) values
collected on 10/14**



**DSI values collected on 9/23
using scale 0 to 5 (Mathew et al. 2015)**



**Sunflower yield (lb/A) values
collected on 10/14**



RESULTS

- Correlations between
 - DSI and NDVI (GreenSeeker)
($r = -0.68$; $p = 3.6e-07$)
 - NDVI (GreenSeeker) and yield
($r = 0.10$; $p = \text{NS}$)
 - DSI and NDVI (multispectral sensor)
($r = 0.21$; $p = \text{NS}$)
 - NDVI (multispectral sensor) and yield
($r = 0.13$; $p = \text{NS}$)
 - GreenSeeker and multispectral sensor
($r = -0.341$; $p = 0.023$)



SUMMARY

- Significant differences in NDVI (GreenSeeker and multispectral sensor) and DSI were observed among fungicides and non-treated control.
- Correlation analyses between NDVI (Greenseeker) and DSI($r = -0.68$; $p = 3.6e-07$) shows that Phomopsis stem canker severity was associated with a decrease in NDVI values



SUMMARY

- The handheld sensor and drone imagery was useful to assess whether the target plots being observed in the field contains healthy vegetation.



FUTURE WORK

- Evaluate fungicides against Phomopsis stem canker using remote sensing technology under field conditions in South Dakota in 2021



THANK YOU!

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