

Monitoring Cover Crop Biomass and Starter Nitrogen Effects on Corn Using in Season Drone Imagery

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Introduction

As a cover crop, rye builds biomass to assist with erosion and weed reduction. Later termination allows for greater biomass, however, this may also reduce nitrogen (N) availability to the following cash crop. To encourage later termination, adjustment of starter N rates may be necessary.

Field Methods

- Two year study (2018 and 2019)
- Performed across northeastern states
 - MD, DE, PA, NY, MA
 - *Only DE presented here*
- Three rye termination timings
 - Early (tillering), Mid(boot), Late(anthesis)
- Four starter N rates:
 - 0, 28, 56, and 84 kg ha⁻¹
- Three total N rates
 - 0, 168, and 285 kg ha⁻¹

Drone Imagery

- Drone flights were performed at the Delaware study site in 2018 and 2019 using a multispectral camera.
- Imagery was processed into vegetative index values by Pix4DMapper:
 - NDVI, GNDVI, NDRE
- Plot maps were created in AutoCAD Civil 3D for feature extraction.
- Average vegetative index values were calculated in ArcMAP using Zonal statistics.

Figure 1: Vegetative indexes (NDVI, GNDVI, and NDRE) from early termination (tillering) and early corn reproductive stages (R2/R3).

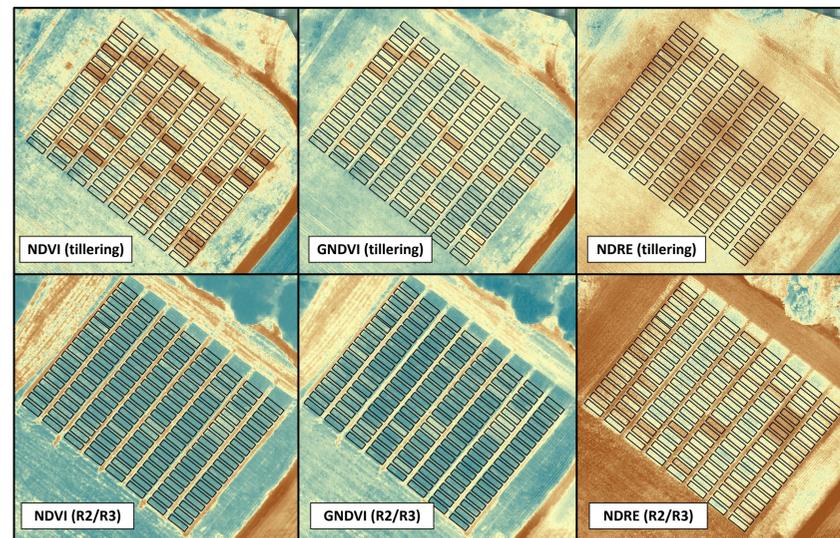


Figure 2: Correlation of yield to NDVI, GNDVI and NDRE for corn in 2018.

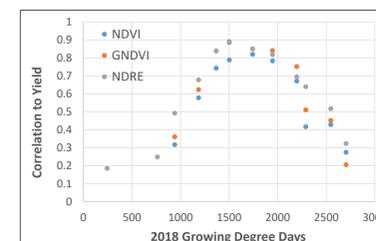
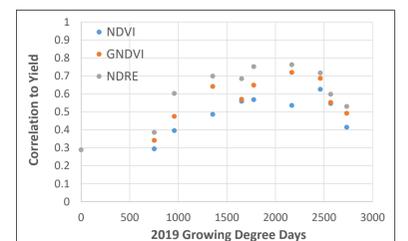


Figure 3: Correlation of yield to NDVI, GNDVI and NDRE for corn in 2019.



Vegetative Index Correlations to Yield

- All three indexes had their greatest correlations to yield between R1 and R4 corn growth stages.
- NDRE often had the strongest correlation to yield followed by GNDVI and then NDVI.
- The strongest observed correlation was 0.89 for NDRE in 2018.

Yield by Termination Timing

- Yields were not affected by termination timing in 2018 but were greater with a cover crop in 2019.

Indexes by Termination Timing

- Early termination took two weeks to have similar NDVI to no-cover treatments
- At corn planting, both no-cover and early termination had the greatest NDVI, GNDVI or NDRE, indicating weed pressure.
- In early corn vegetative stages, late termination had greater index values, with differences more apparent by NDVI and after sidedress applications.

Yield by Starter Nitrogen

- In both 2018 and 2019, yields were increased by any rate above zero, but they were not different.

Indexes by Starter Nitrogen

- NDVI observed differences in starter two weeks after planting and again at corn reproductive stages.
- In 2018, GNDVI and NDRE observed differences in starter rates from late vegetative through black layer.
- In 2019, GNDVI and NDRE observed differences in starter rates at late vegetative and dent growth stages.
- All differences were between any starter and no starter.

Yield by Total Nitrogen

- In both years, both 168 and 285 kg N ha⁻¹ had greater yields than no N.

Indexes by Total Nitrogen

- In 2018, NDVI didn't observe total N effects until reproductive stages, while GNDVI and NDRE picked up differences from late vegetative to blacklayer stages.
- In 2019, NDVI, GNDVI, and NDRE all observed greater values in both N application rates versus no N from VT until blacklayer.
- At blacklayer, NDVI and NDRE were able to separate the 168 and 285 kg N rates.

Summary and Conclusions

- Although termination timing had no effects on final yield, vegetative indexes helped measure termination effects on cover crops as well as early season differences in corn growth.
- The use of starter increased yields, and vegetative indexes revealed that starter N was important during reproductive corn growth stages.
- The effects of total N application were also apparent at reproductive stages, and vegetative indexes also had their strongest correlations to yield. As in other N studies, NDRE had the strongest relationship.
- As a research tool, drone imagery may assist in measuring plot characteristics throughout the season in N studies.



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