Adapting cover crop management to current climate conditions in continuous corn systems in eastern Nebraska

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Background

- Ecosystem benefits of cover crops (CC) depend on cropping system, climate, soil, and crop management.
- Crucial to identify management practices that maximize benefits and reduce tradeoffs (e.g., competition with main crop)
- Crop simulation models are ideal tools to identify optimum management practices by testing outcome of CC under numerous GxExM combinations.

Objectives

- Calibrate/validate Decision Support System for Agrotechnology Transfer (DSSAT) for corn and cereal rye varieties.
- Identify a suitable termination date with respect to biomass, corn yield, and termination efficiency

Data and Methods

- Study site: Eastern Nebraska Research, Education, and Extension Center (ENREEC), Mead, Nebraska.
- Continuous corn under rainfed conditions.
- Climate change scenario: CanESM2 GCM downscaled using CanRCM4 Regional Climate Model 4 under RCP4.5 and 8.5.
- Simulation length: 30-years for each treatment
- Treatments:
  - 15 termination dates (March 22nd to May 31st)
  - Corn with (CC) & without (NCC) cereal rye cover crop;
  - Hist (1991-2020) vs future (2041-2070)

Birru, G., Shiferaw, A., Tadesse, T., Schmer, M. R., Jin, V. L., Wardlow, B., Koehler-Cole, K., Awada, T., Beebout, S., Tsegaye, T., & Kahrel, T. (2023). Simulated impacts of winter rye cover crop on continuous corn yield and soil parameters. Agronomy Journal, 115, 1114–1130.

Results

Calibration/validation of DSSAT

- Calibrated DSSAT CERES-Maize model for P1197 (Pioneer) corn hybrid & CERES-Wheat model for Elbon cereal rye variety (Fig 1.; Birru, G. et al.

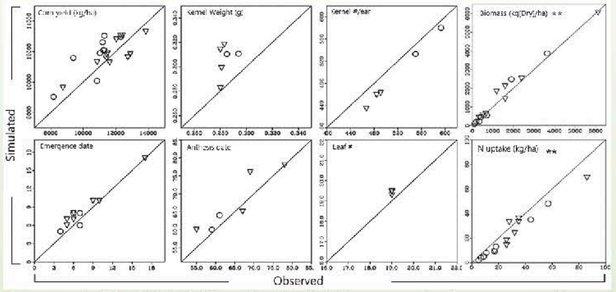


Figure 1: DSSAT Calibration/validation results for corn and cereal rye (**) (Birru, G. et al. (2023).

Termination date vs CC biomass

- CC biomass ranged from 0.113 Mg/ha for March 22 to 3.9 Mg/ha for May 31 termination date ($p<0.05$) (Fig 2).
- increased at an average rate of 30% for every 5-day delay in termination
- N content decreased from 3.35% for earliest to 1% for latest termination date.
- Cumulative Net mineralization during corn growing season decreased slightly due to N tied up in CC residue with high C:N ratio (Fig 3a).
- Accelerated CC residue decomposition for delayed termination dates due to increased soil temperature and moisture.
- Up to 10% (40%) of total Net mineralization in the 1st 4 weeks after corn planting for earliest (latest) termination dates (Fig 3b).

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Termination date vs corn yield

- No statistically significant yield differences between early and late termination dates ($p<0.05$).
- Delayed termination increased competition between CC and corn.
- Yield reduction (CC vs NCC): increased from 1.6% for early to 6.2% for delayed termination (Fig 2).

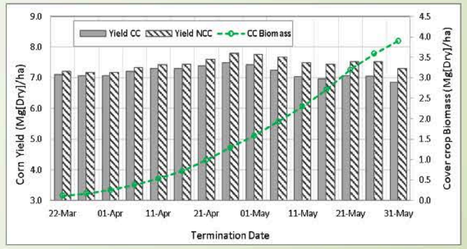


Figure 2: CC biomass (line), corn yield for CC (solid bars)and NCC (stripe bars) for 15 termination dates

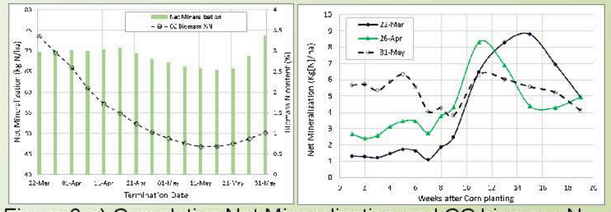


Figure 3:a) Cumulative Net Mineralization and CC biomass N % ; b) weekly Net mineralization for Mar 22nd , April 26th , and May 31st Termination dates

Termination date vs CC growth stage

- Recommended practice for grass CC species: before heading stages (<50).
- CC growth stage at termination ranged from 19.6 (end of seedling growth) to 83.6 (dough) & canopy height from 29cm to 117cm for Mar 22nd and May 31st termination dates, respectively (Fig 4).
- Dates after May 1st : CC past heading stage (>=50): unsuitable dates
- Preferred date: May 1st (45.9- boot stage; Canopy height - 71 cm; Biomass - 1.59 Mg[Dry]/ha)

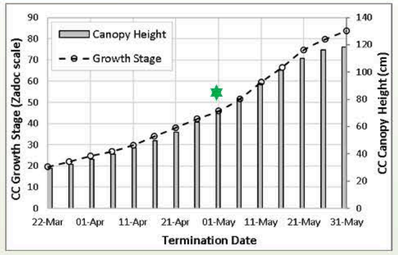


Figure 4: CC growth stage and canopy height (cm) at time of termination

Termination-Corn planting Interval

- 1, 5, 10, 15 and 20-day interval for corn planted on May 11th
- For every 5-day increase in interval, corn yield (CC biomass) increased (decreased) by ~80 kg/ha (325 kg/ha)
- Difference in yield (CC biomass) between 1-day vs 20-day interval only 325 kg/ha (-1304 kg/ha) (Fig 5).

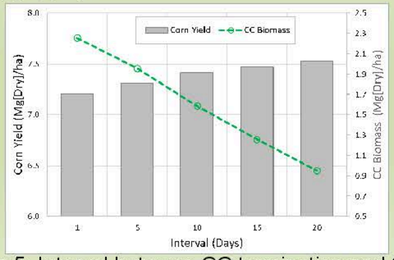


Figure 5: Interval between CC termination and Corn planting

Conclusion

- No significant corn yield difference between early and late termination dates
- Delayed termination increased risk of competition with main crop.
- CC biomass increased with termination, but N content reduced
- Delayed termination after May 1st would likely reduce termination efficiency.