Cover crops and drought: implications for climate resilience

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QUESTION

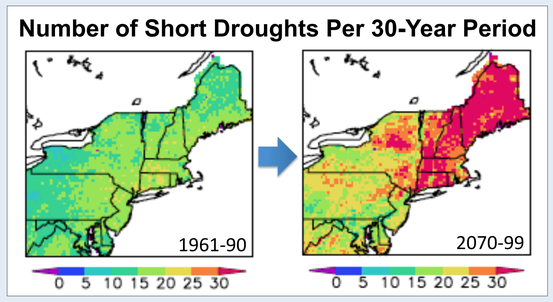
How does cover cropping impact maize yield under late summer drought conditions?

MOTIVATION

Cover crops may aid climate adaptation

- Protect soil against extreme precipitation
- Increase soil organic matter, improve soil structure, and increase water-holding capacity
- Supply nitrogen (N) in sync with crop demand
- Conserve soil moisture and reduce soil temperature when retained as a mulch

More late-summer droughts projected



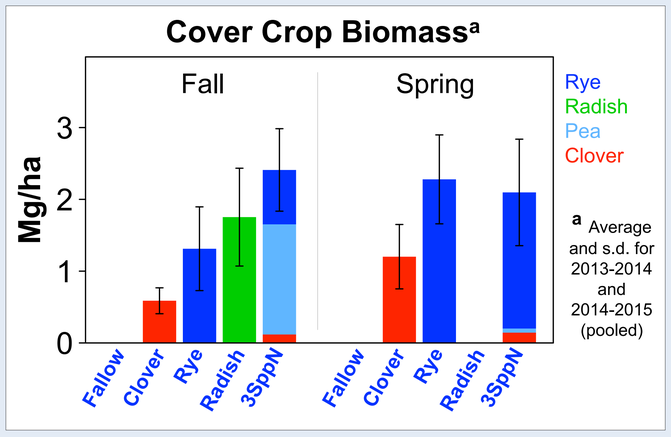
Hayhoe et al. 2007. Clim Dyn *28*, 381-407.

HYPOTHESES

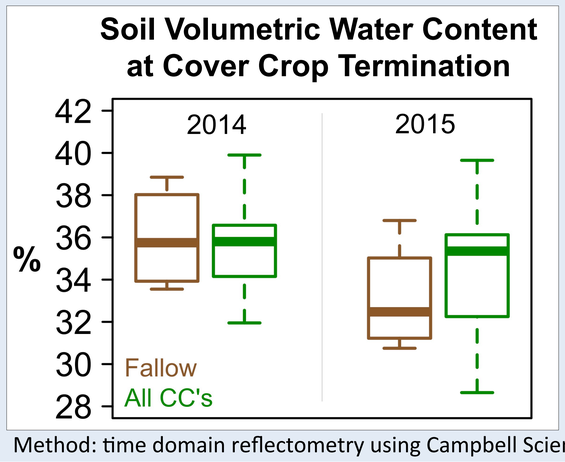
1 Cover crop transpiration reduces soil plant available water (PAW) if spring rains are inadequate

2 Cover crop N provisioning reduces maize drought stress and N immobilization increases drought stress

H1 Cover crop transpiration did not affect soil PAW at termination



Soil volumetric water content at termination did not differ between the fallow control and any cover-cropped treatment in either year, regardless of cover crop biomass production and winter-hardiness



Method: time domain reflectometry using Campbell Scientific TDR100

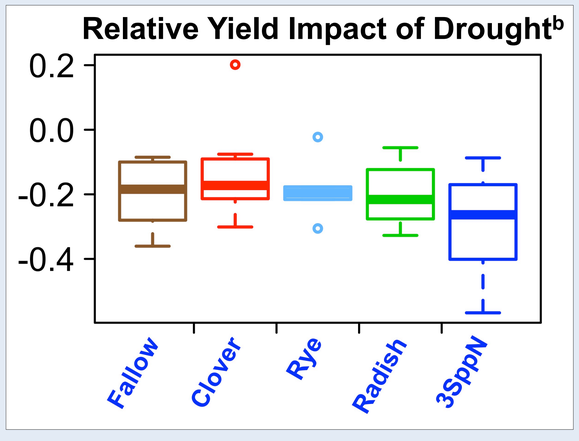
Consistent rains replaced soil water transpired by cover crops

- Avg. April precip. = 8.1 cm
- 2014 = 6.9 cm
- 2015 = 8.9 cm

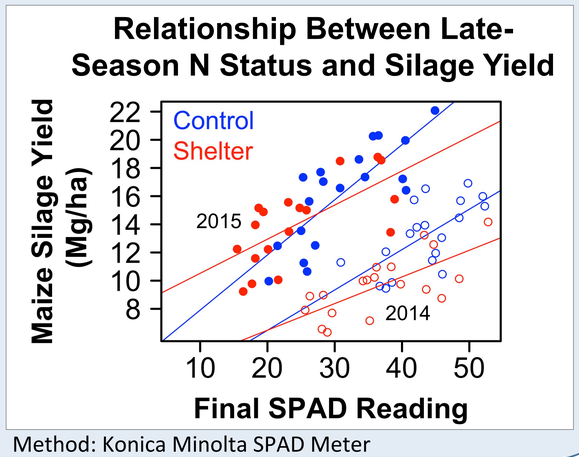
H2 No evidence of N effect on maize yield response to drought

Relative yield impact of drought did not differ among cover crop treatments

[b] Relative yield impact = $\frac{(\text{Yield}_{\text{shelter}} - \text{Yield}_{\text{control}})}{\text{Yield}_{\text{control}}}$



Maize grown in rainout shelter plots appears less responsive to N status (smaller slope), though the difference is not significant ($p > .15$)



Method: Konica Minolta SPAD Meter

ACKNOWLEDGEMENTS

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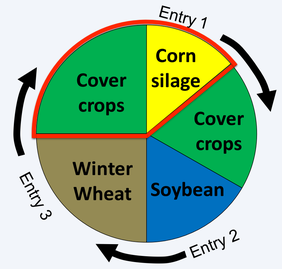
METHODS

ORGANIC FIELD EXPERIMENT

3 entries, 4 blocks



Full tillage

CORN-SOY-WHEAT ROTATION

Cover crops planted after wheat
- 2013/14: planted 8/8 and terminated 5/8-9
- 2014/15: planted 8/15 and terminated 5/4

Silage corn planted after plow-down
- 2014: planted 6/2 and harvested 9/17
- 2015: planted 5/28 and harvested 9/21-22

FERTILIZED WITH MANURE

45 Mg/ha dairy bed pack
- Applied at cover crop termination
- Incorporated with cover crop residues

5 COVER CROP TREATMENTS

- Fallow (tilled to control weeds)
- Red clover (*Trifolium pratense*)
- Cereal rye (*Secale cereale*)
- Radish (*Raphanus sativus*)
- 3 Species Nitrogen Mix:
  - cereal rye, red clover, Austrian winter pea (*Pisum sativum*)

RAINOUT SHELTERS PAIRED WITH CONTROL PLOTS

20 pairs of plots

ADDITIONAL METHODS

1) Corn height (weekly)
2) Leaf area index (weekly)
3) Leaf stomatal conductance (weekly)
4) Pre-dawn water potential (bi-weekly)
5) Yield components & nutrient analysis
6) N mineralization cores