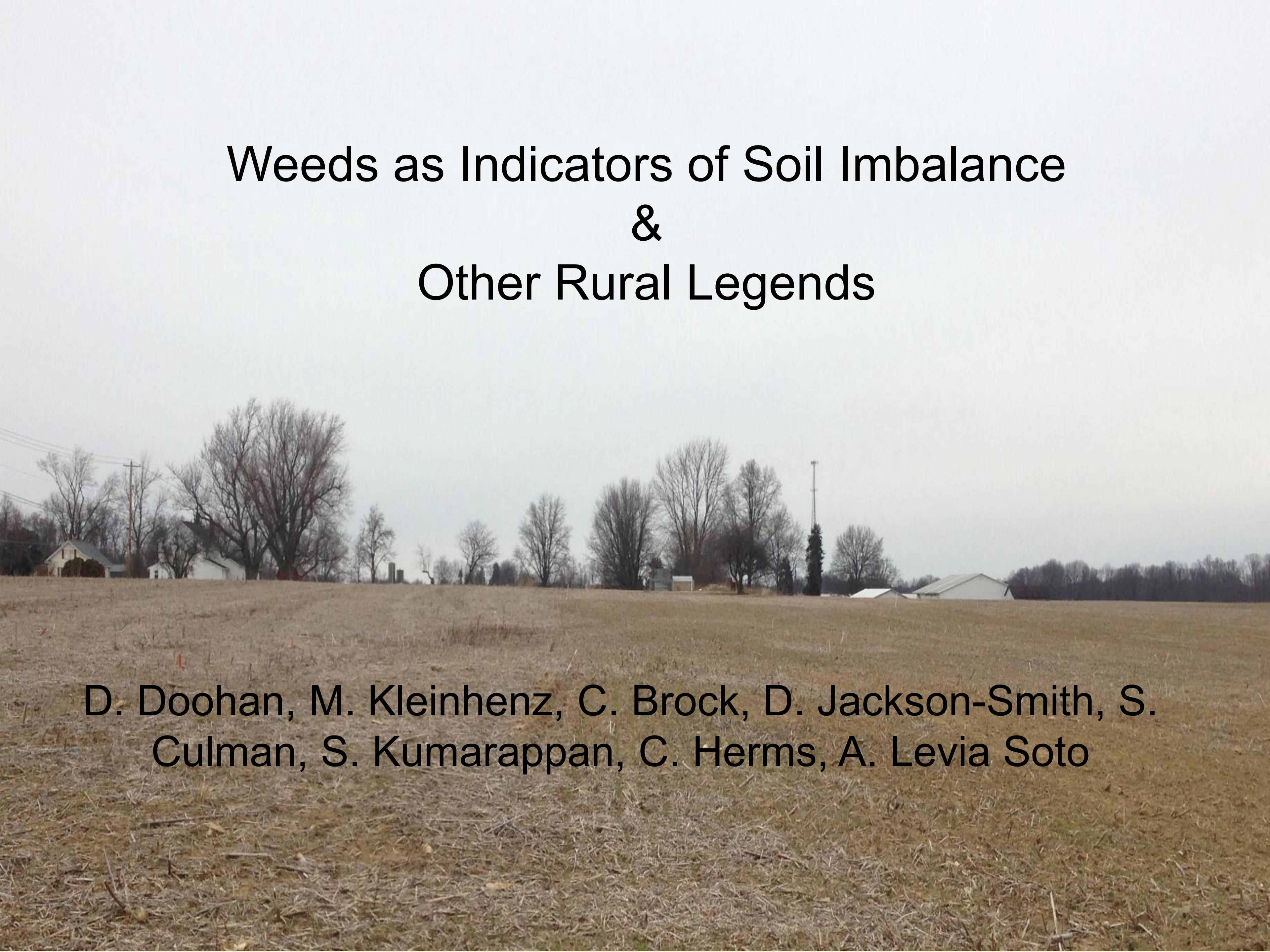
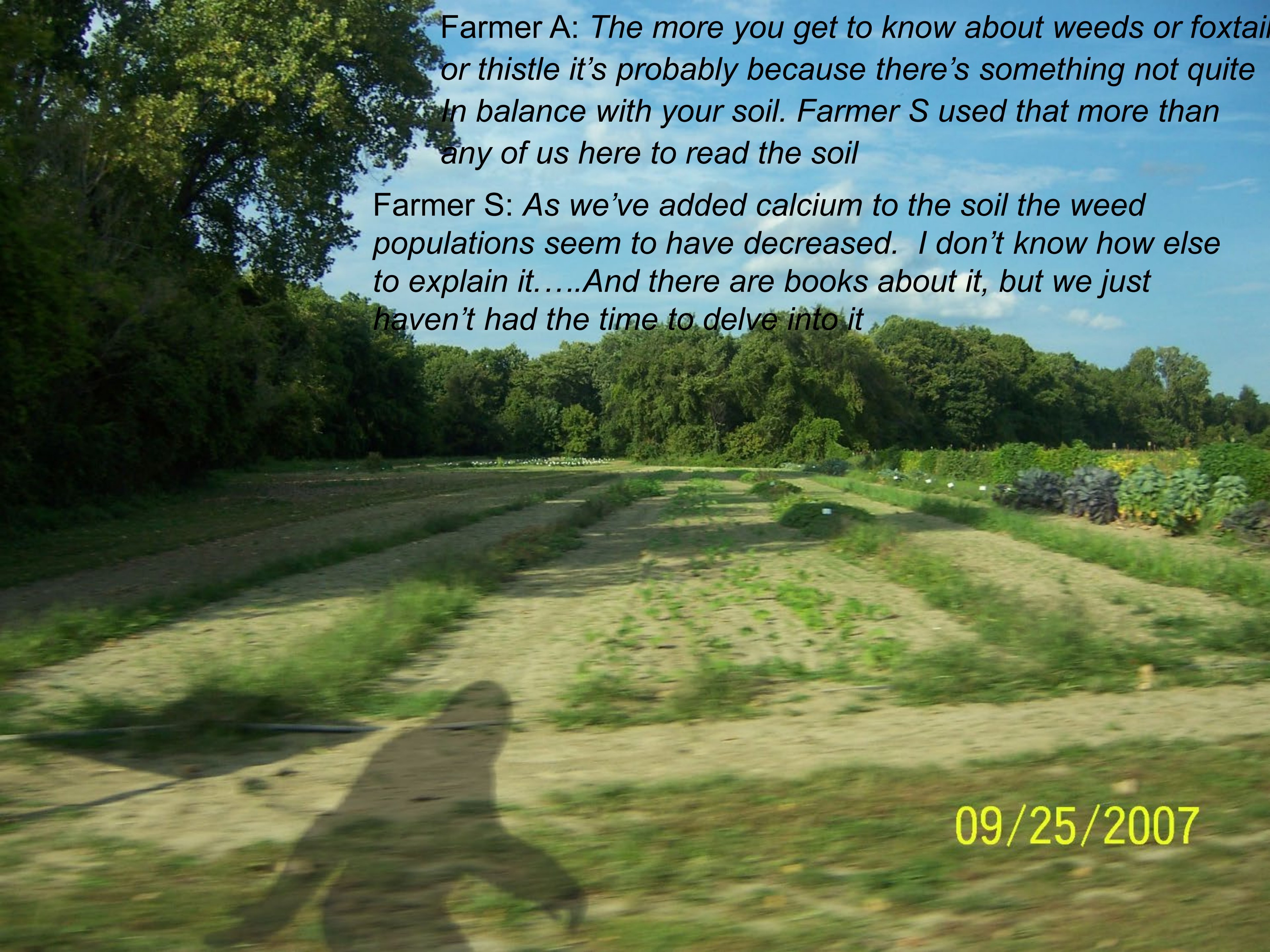


Weeds as Indicators of Soil Imbalance
&
Other Rural Legends

D. Doohan, M. Kleinhenz, C. Brock, D. Jackson-Smith, S. Culman, S. Kumarappan, C. Herms, A. Levia Soto

Farmer A: *The more you get to know about weeds or foxtai or thistle it's probably because there's something not quite In balance with your soil. Farmer S used that more than any of us here to read the soil*

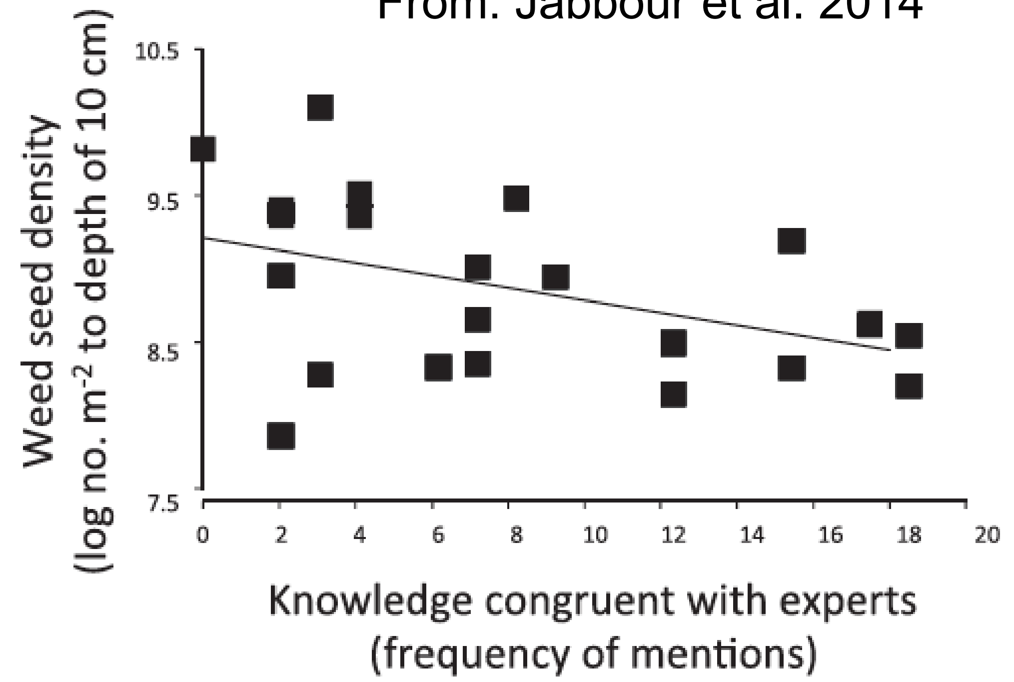
Farmer S: *As we've added calcium to the soil the weed populations seem to have decreased. I don't know how else to explain it…..And there are books about it, but we just haven't had the time to delve into it*



Why care about soil balancing?

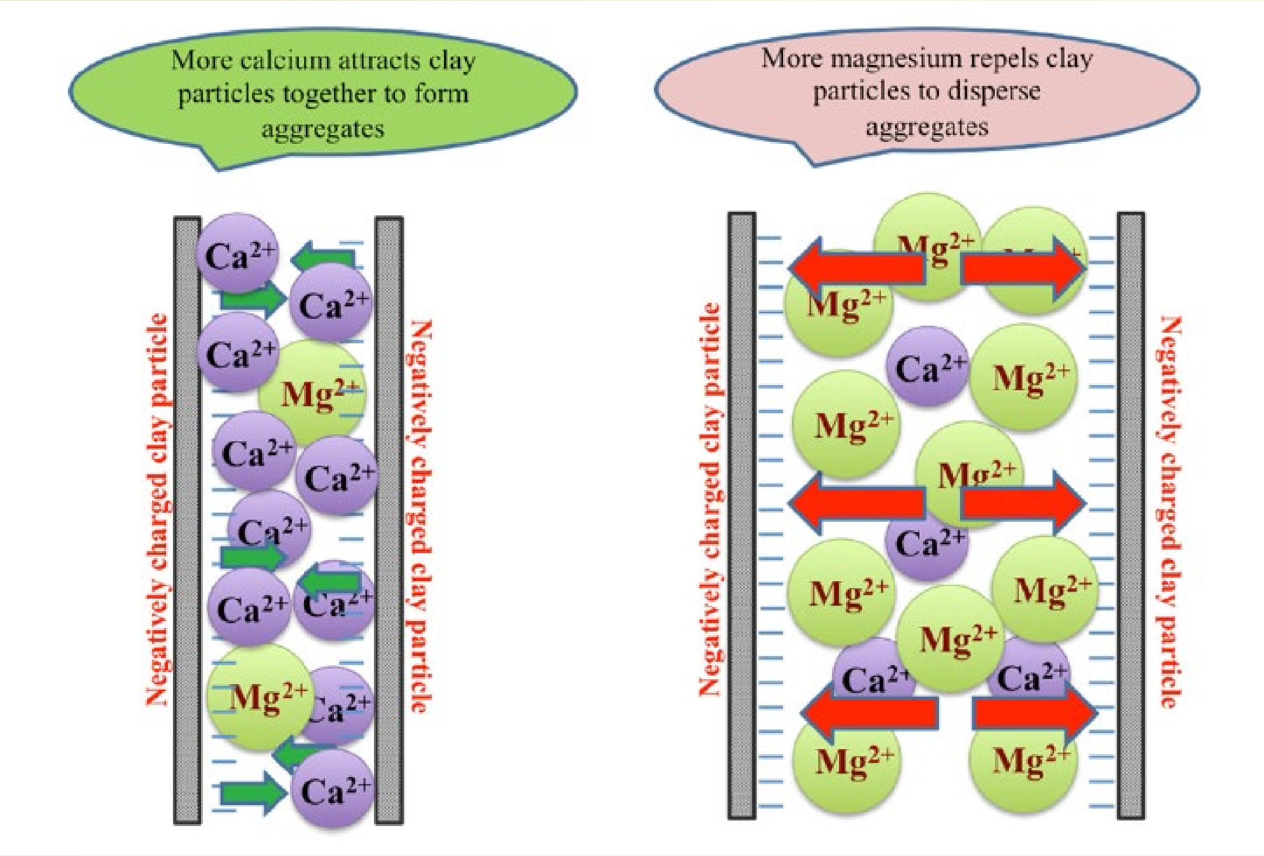
- 5.4 million certified organic acres (USDA 2011)
  - *If typical soil balancing amendments were applied to even 5-10% of certified organic, the cost would be $40-100 million*
- As of 2019, several hundred thousand acres of conventionally managed heavy clays in Ohio are managed using the BCSR approach

From: Jabbour et al. 2014



It will soon be proved to academia's satisfaction that a proper calcium level …..will do more to roll back weed proliferation than all the herbicides in the Dow and Monsanto armamentarium – C. Walters, 1991

Theoretical basis?



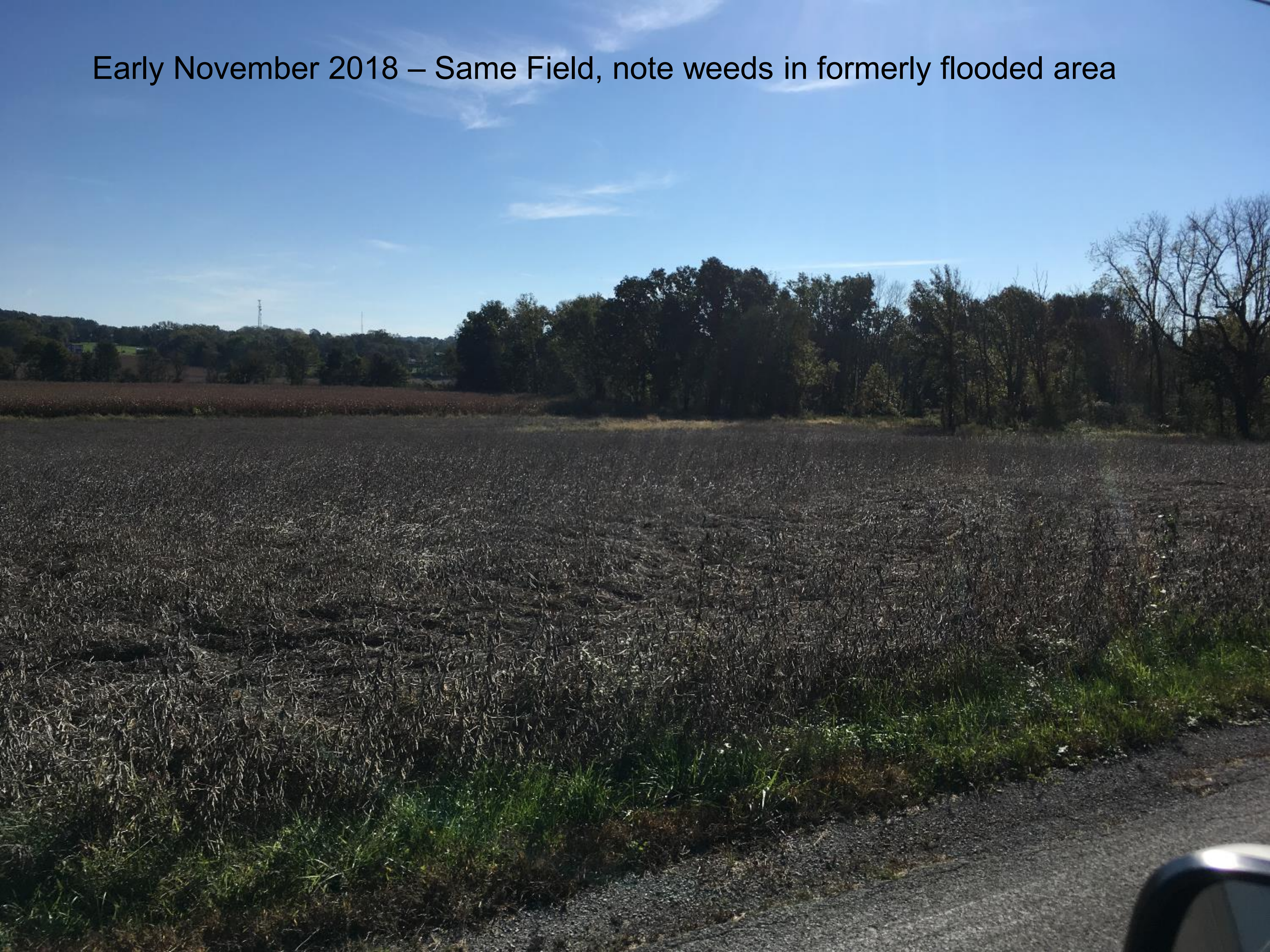
Chaganti & Culman 2017. Crop, Forage, & Turfgrass Mgmt

"When we start working with guys we always have 'problem' fields … undoubtedly we find that the Ca:Mg relationship is their main challenge."

-Joe Nester, Ohio crop consultant


Early June 2018

Early November 2018 – Same Field, note weeds in formerly flooded area



Our experimental hypothesis was that SOIL BALANCING would have no consistent effect on soil biology or chemistry, crop yield or quality, weeds, insect pests, or farm profit potential.

Collaborative Research & Extension Project

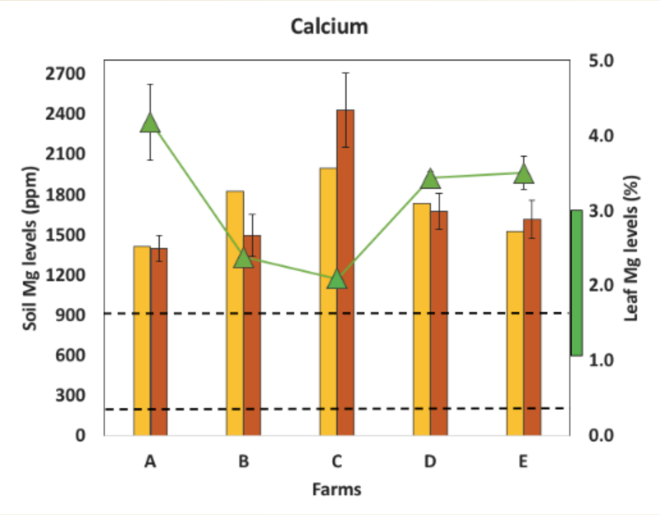
4 experiment station/ 18 farms

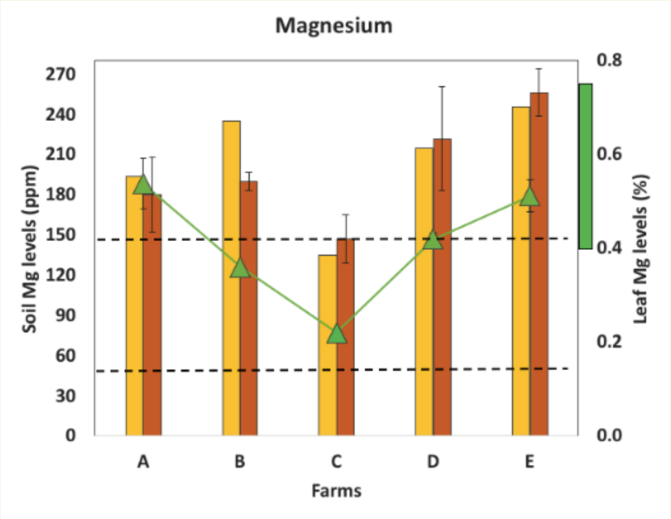
- **Soil amendments:**
  - Gypsum
  - Limestone (Dolomite or HiCal)
  - Epsom
  - Sulfur
  - BCSR +
- **Crop Rotations:**
  - Field Crop: Corn, soybean,alfalfa, Oats/Wheat underseeded with clover
  - Vegetable: Squash, pop corn, edamame, green bean
- **Data**
  - Soil chemistry, physics, biology
  - Crop nutrient content & yield
  - Soil weed seed bank
  - Emerged weed density
  - Crop nutrient content & yield

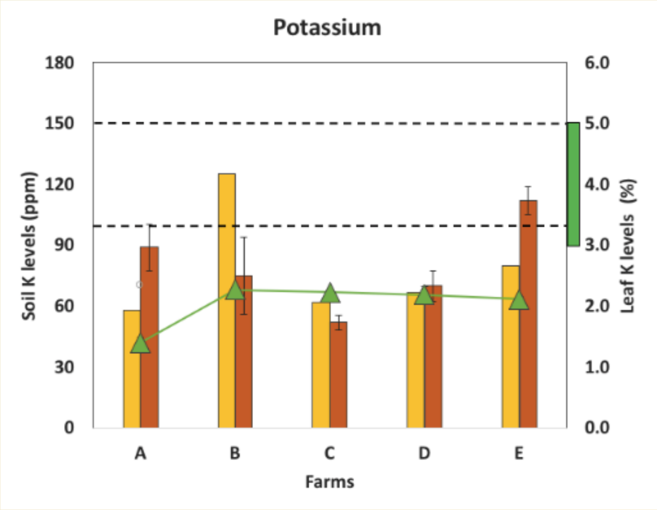
List of negative results

- No effect on yield of corn, soybean, or cereal grains
- No consistent effects on soil biology or vegetable crop quality
- No consistent effects on soil physics
  - trend lines favoring reduced penetration resistance and greater hydraulic conductivity with higher Ca:Mg

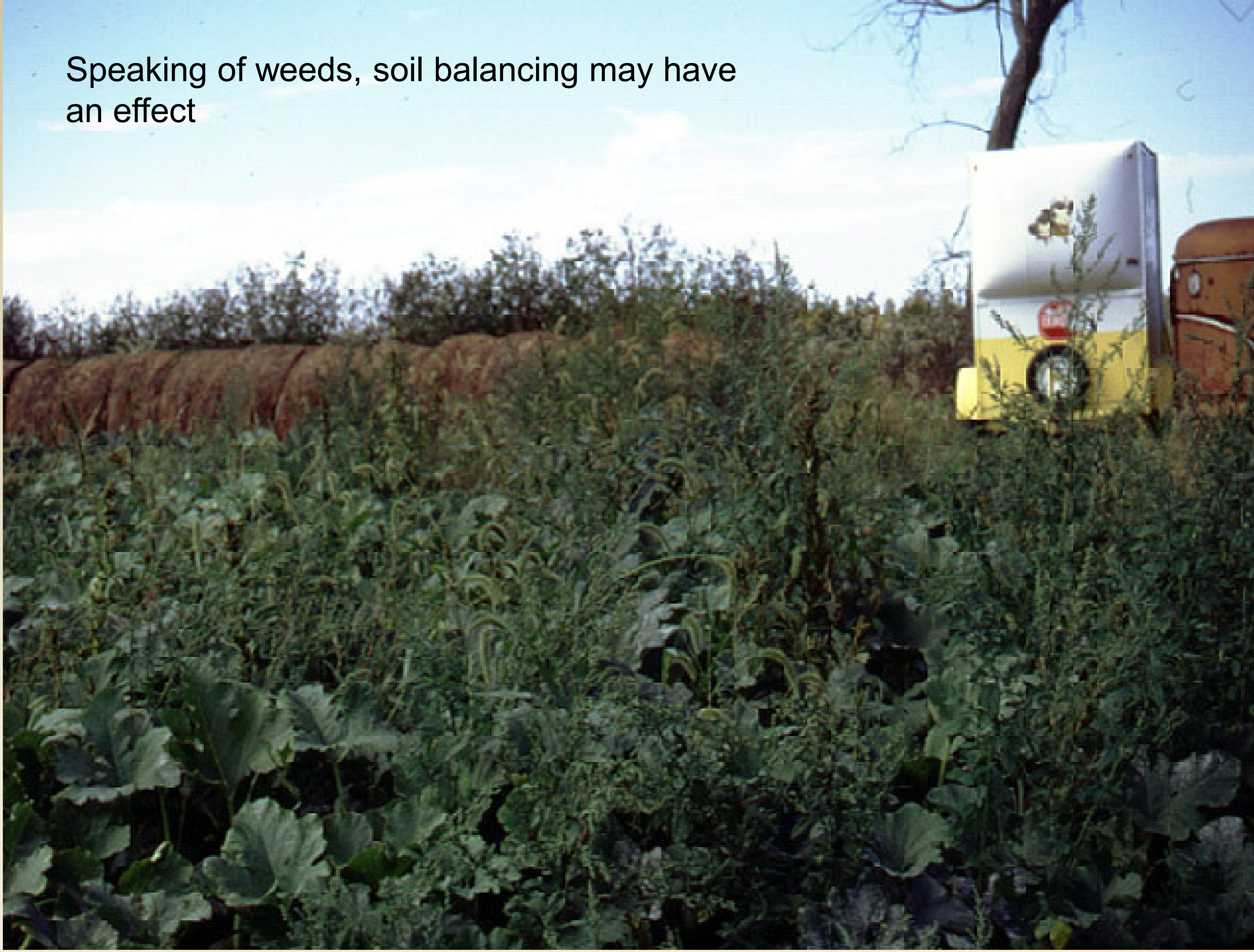
K & Mg crop nutrition is at risk on balanced, low CEC soils



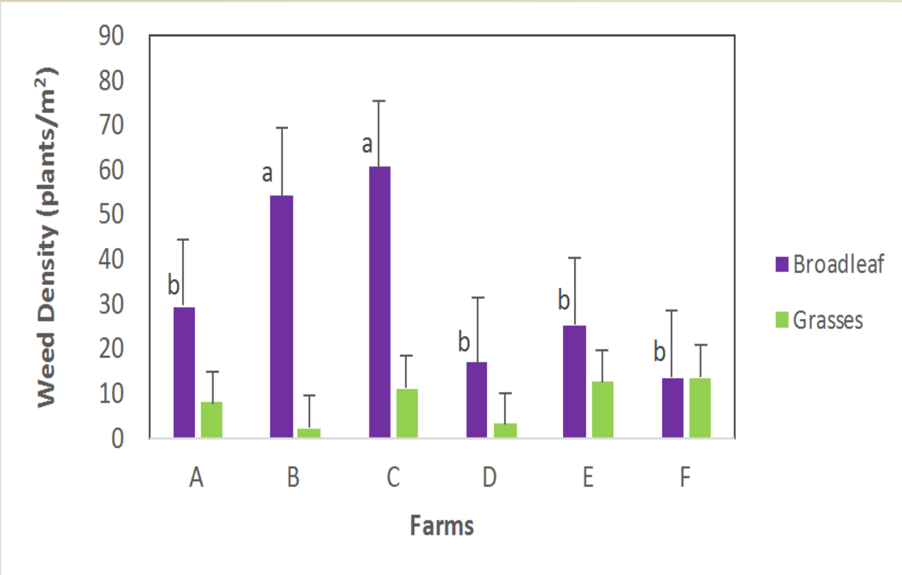




Speaking of weeds, soil balancing may have an effect

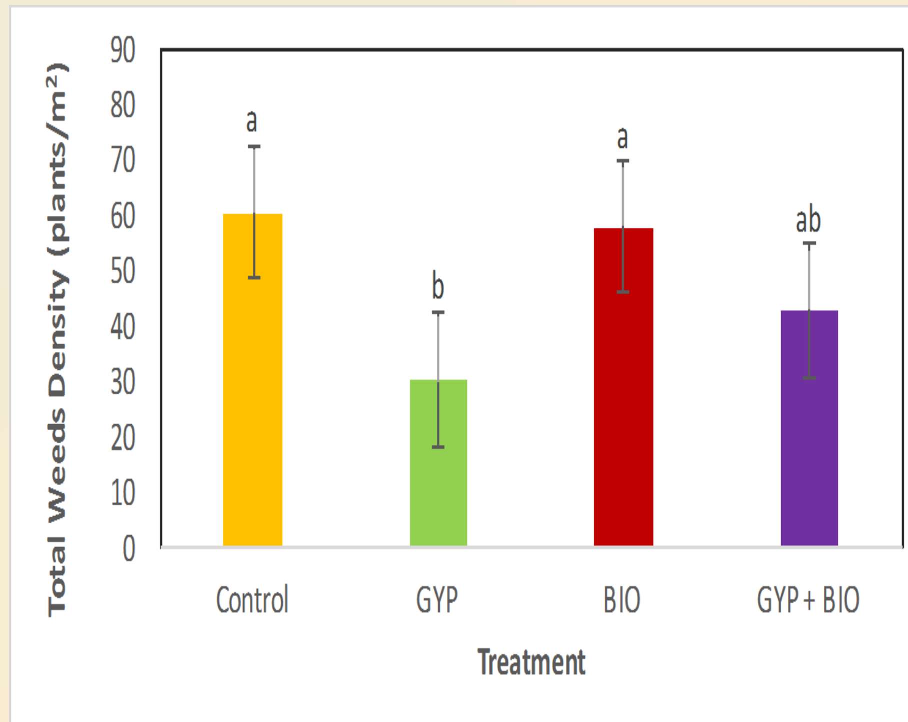


On six vegetable farms where soil balancing had been used, grasses were less prevelant.



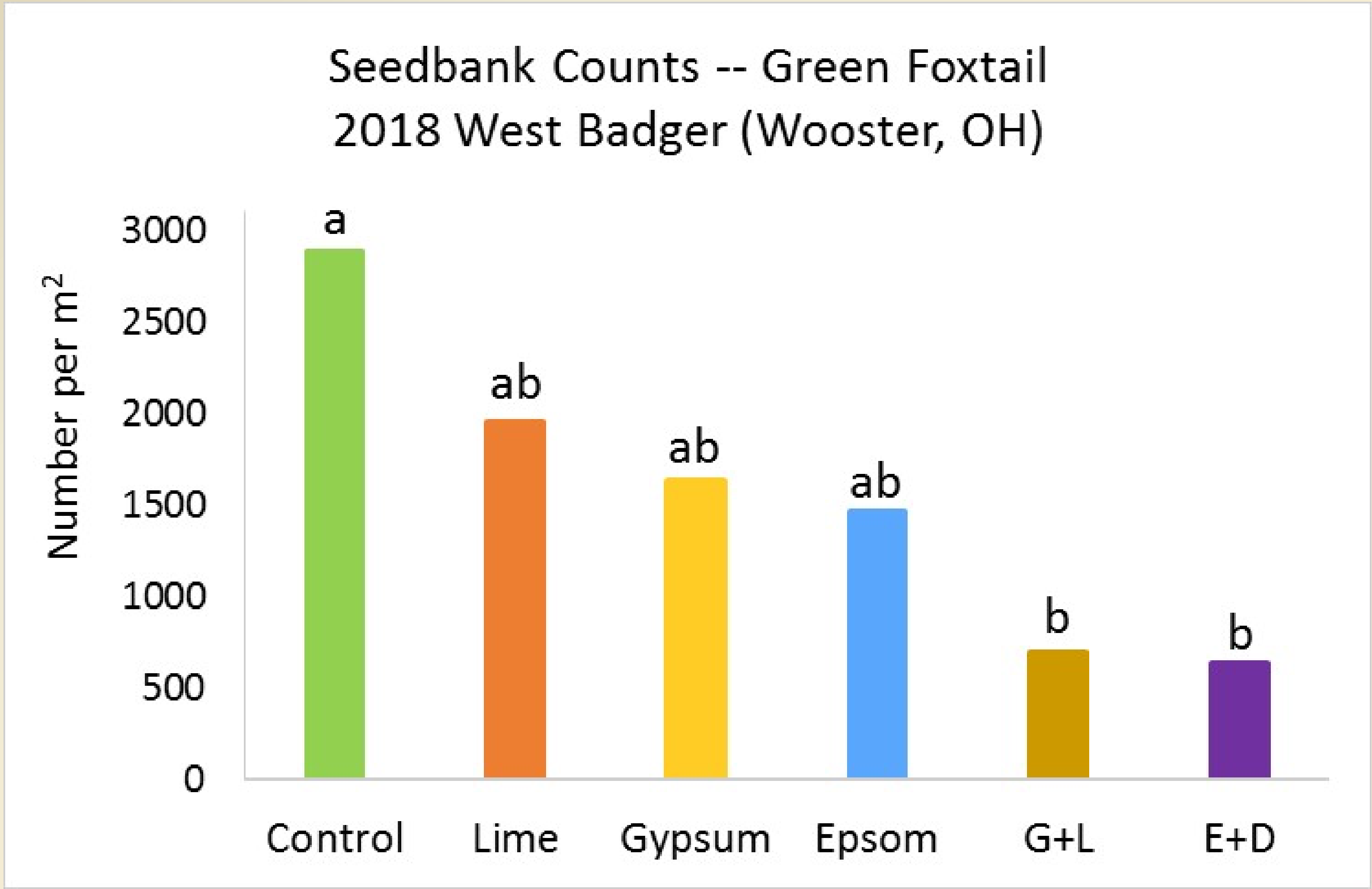
- **Weed Seed Bank**

On one farm total weeds were lower in plots where gypsum was used



Farm B : plots treated with GYP had a lower weed density

No effect on weeds in 2015-2017, but green foxtail was lower in soil samples from plots treated with gypsum + lime and with Epsom salts and dolomite in 2016 and 2017



- Great interest and adherence to soil balancing in the organic farming community
- Calcium-rich amendments applied over 4 years at 8-10 T/ ha increased Ca:Mg ratios into the range of Albrecht's 'ideal soil'
- Green foxtail densities in some high calcium plots were lower than in control plots
- General trend lines towards lower penetration resistance in high calcium amended plots
- K and Mg nutrition at risk on low CEC sands
- No consistent effect of Ca:Mg ratio on soil health
- No evidence for crop yield responses to Ca:Mg or pH changes

Acknowledgement

This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2014-51300-22331 from the USDA National Institute of Food and Agriculture

Research was in cooperation with members of Greenfield Farms Cooperative & Organic Valley