Preventing Soil Acidification

Soil Acidity and Soil Health Workshop
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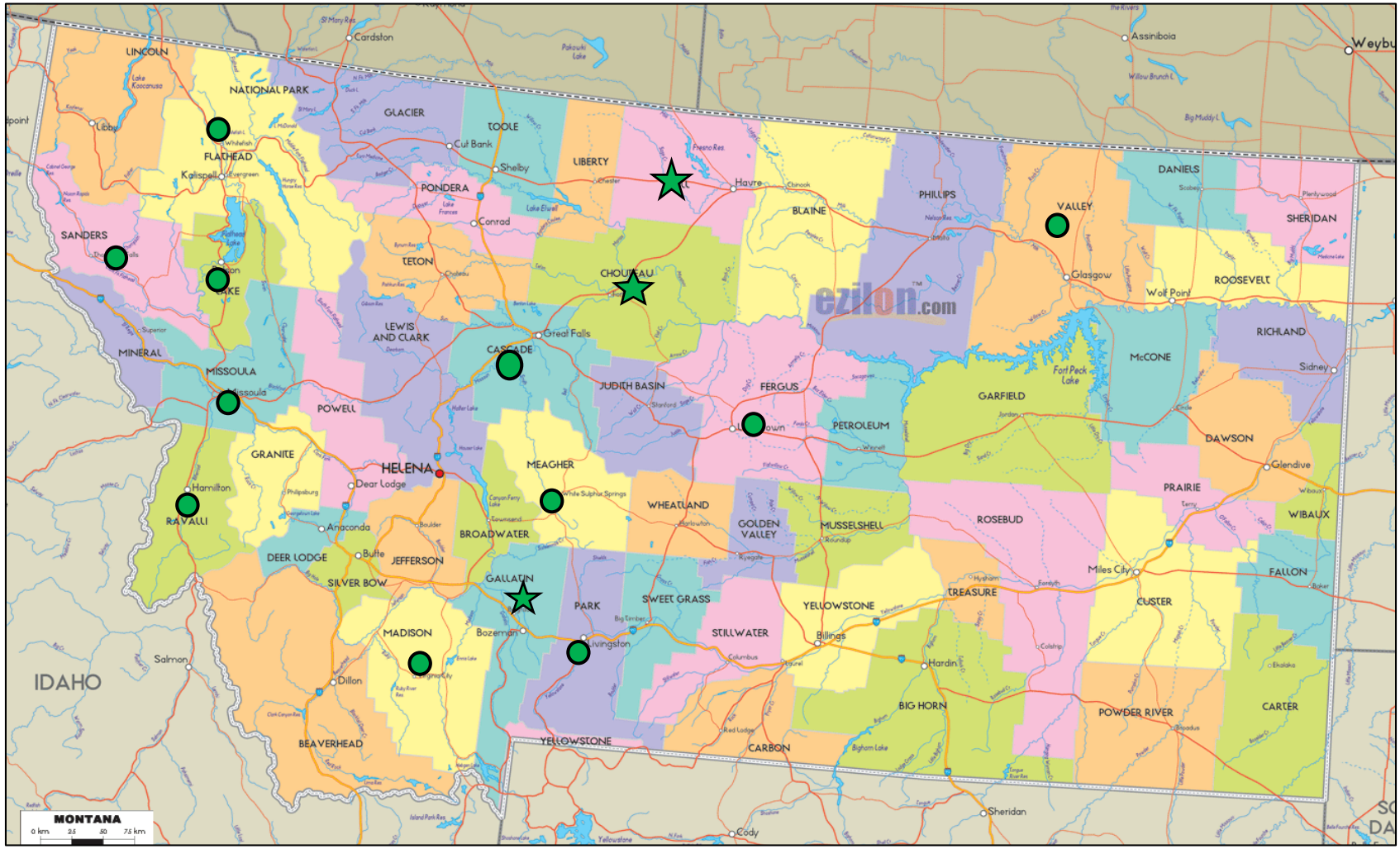
Objectives

Specifically, I will:

1. Show prevalence of acidification in Montana
2. Review acidification's cause and contributing factors
3. Discuss steps to prevent or minimize acidification

Prevalence



★ pH tested by MSU

● pH tested by independent lab

Cause

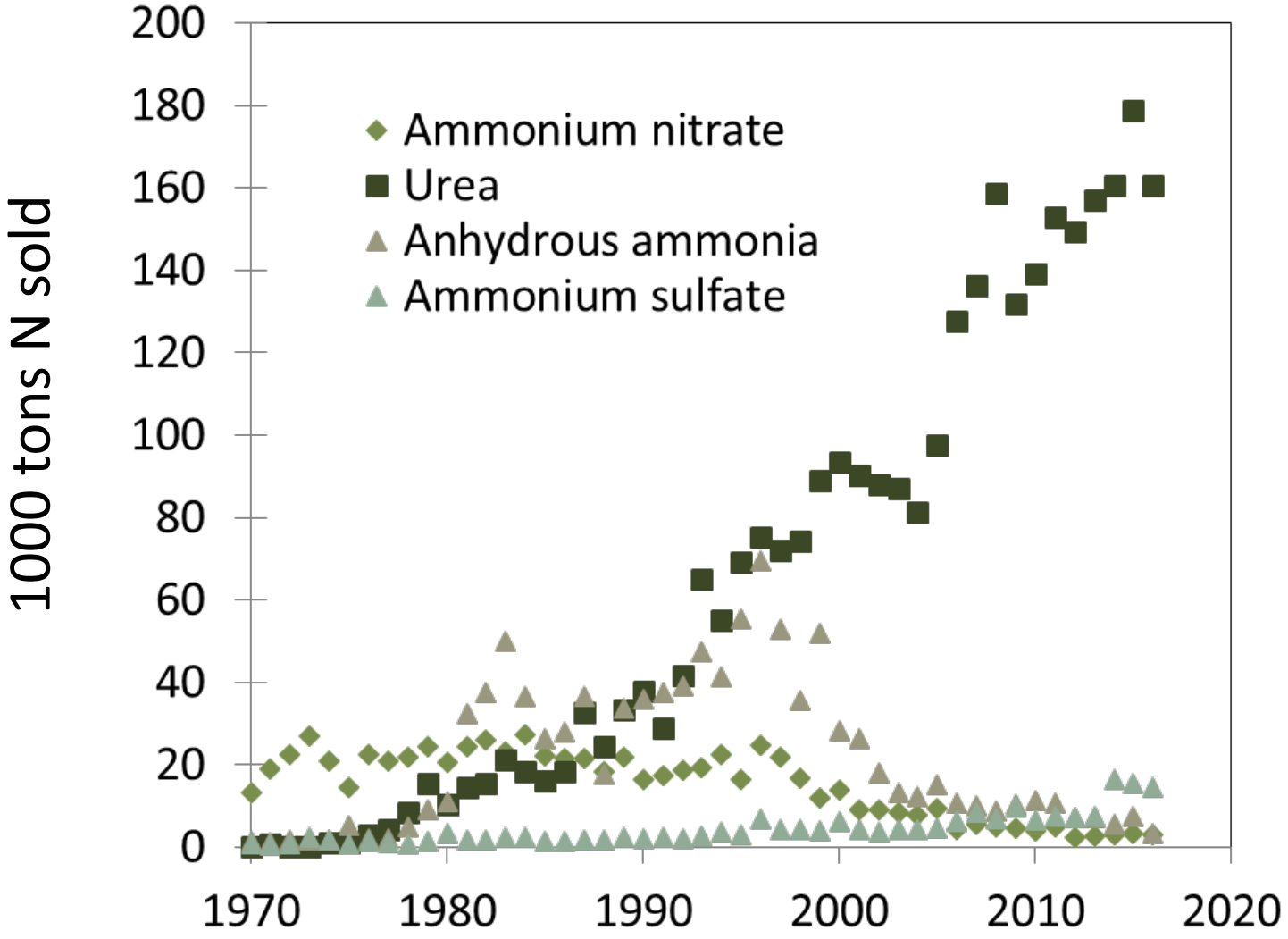
1. Oxidation of ammonium to nitrate is major cause:

Ammonium + oxygen → nitrate + water + acid

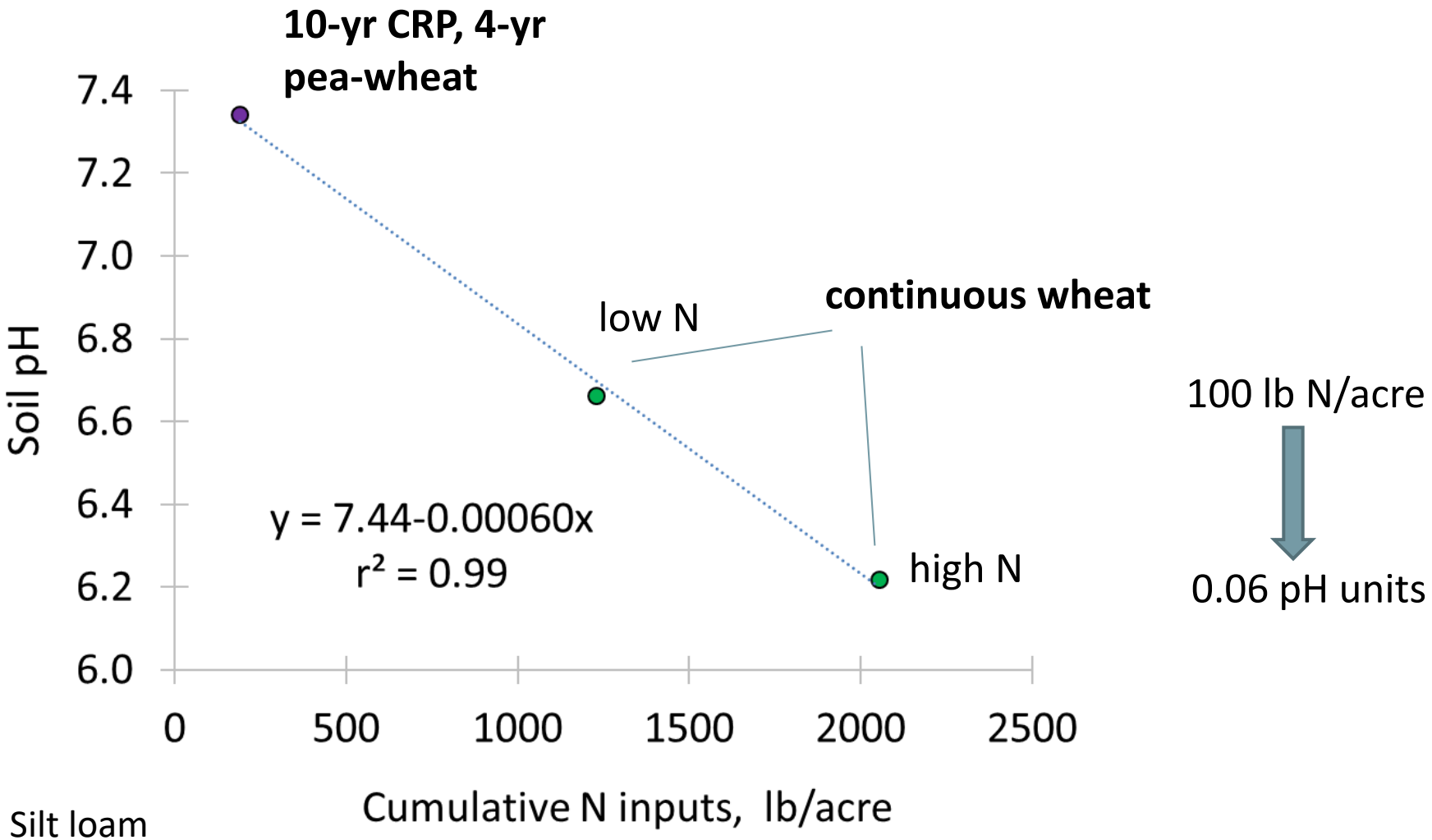
2. The amount of acid depends on source:

- 11-52-0 and 21-0-0-24 produce 2x the acid of 46-0-0, 82-0-0, 28-0-0, or 34-0-0 per unit of N (lb of N)
- Calcium ammonium nitrate (27-0-0) produces minimal acid b/c 20% lime.
- Liquid calcium ammonium nitrate (17-0-0) also shouldn't acidify – mainly nitrate.
- Manure generally raises pH

N fertilizer sold in Montana



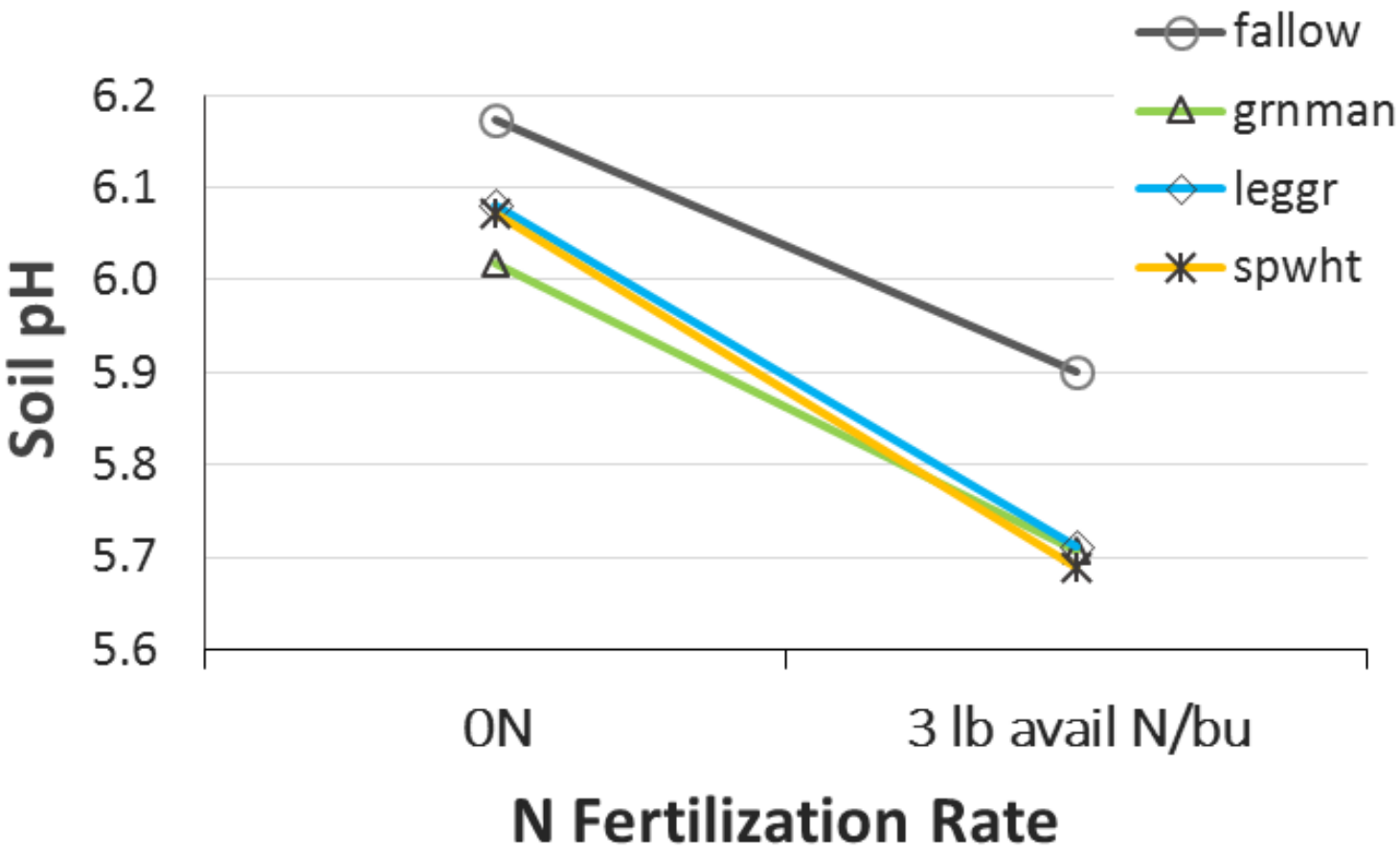
Effect of 14-yr of N fertilization west of Bozeman November 2016



Silt loam

Engel, Ewing, Miller unpub data

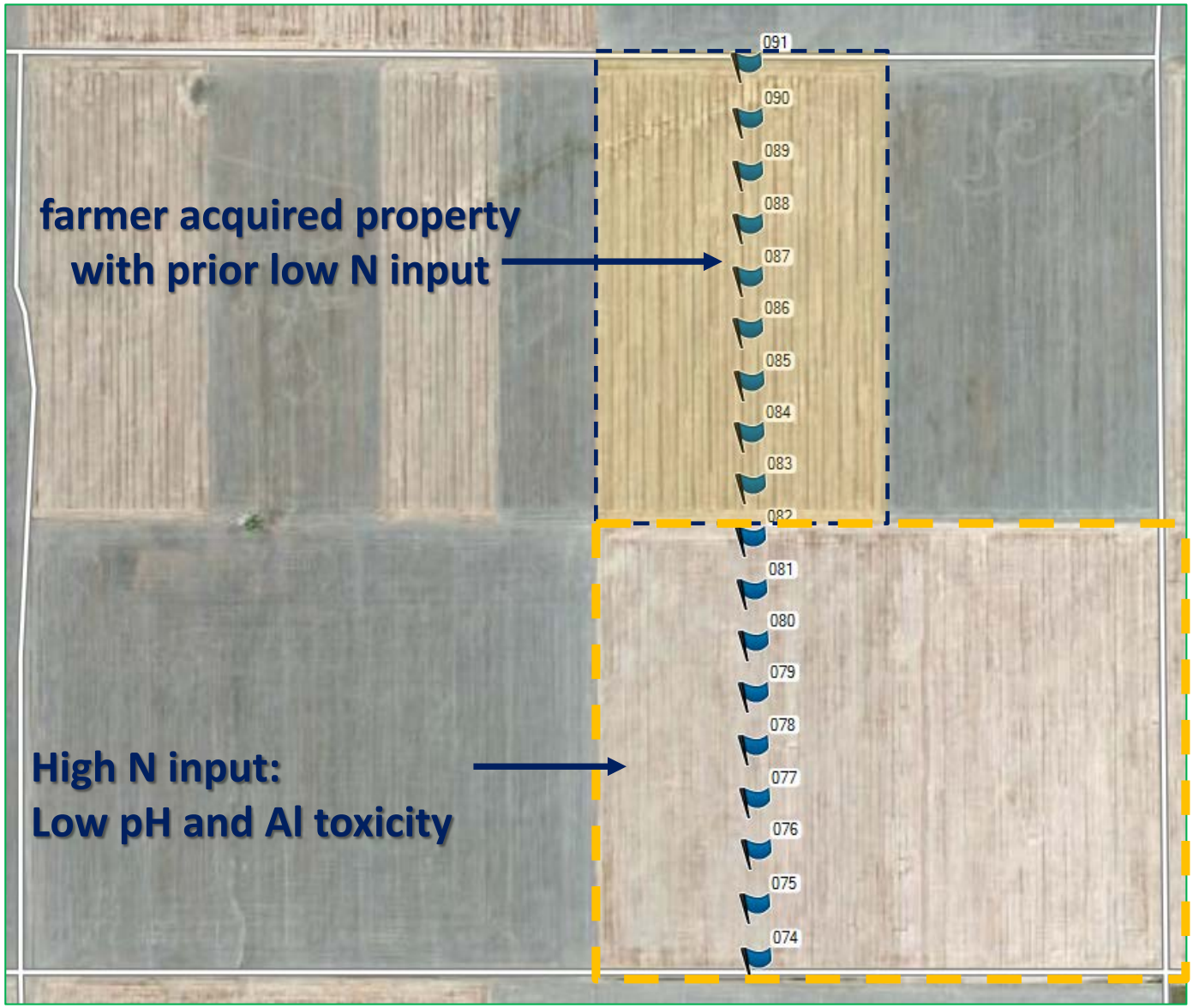
Effect of N fertilizer and crop rotation on pH
West of Big Sandy, October 2017



100 lb N/acre

~0.15 pH units

Legacy effects of N fertilizer – Big Sandy

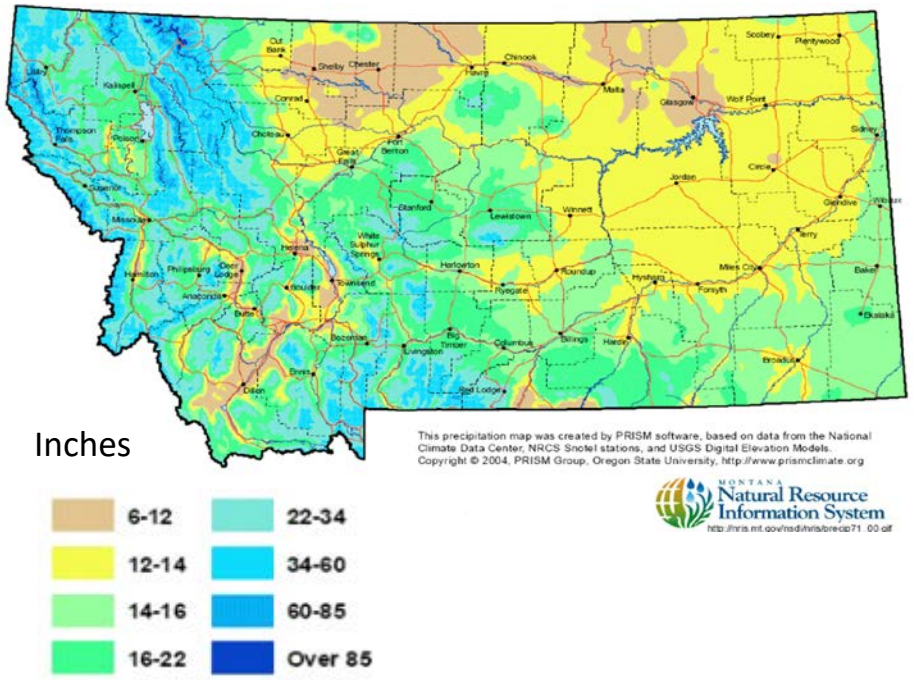


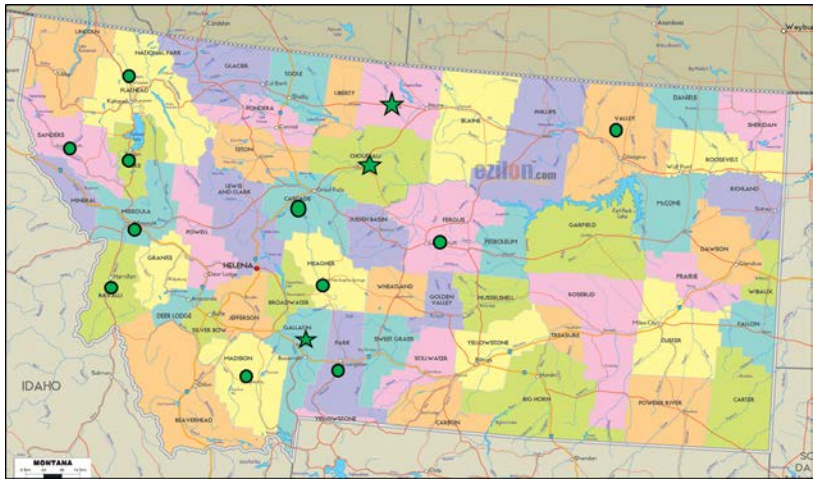
pH_{91}	7.77
pH_{90}	8.15
pH_{89}	7.89
pH_{88}	7.98
pH_{87}	7.67
pH_{86}	6.52
pH_{85}	7.95
pH_{84}	7.80
pH_{83}	6.22
pH_{82}	4.36
pH_{81}	4.42
pH_{80}	4.28
pH_{79}	4.19
pH_{78}	4.76
pH_{77}	4.28
pH_{76}	4.45
pH_{75}	4.18
pH_{74}	4.87

Factors that contribute to acidification (other than N fertilizer)

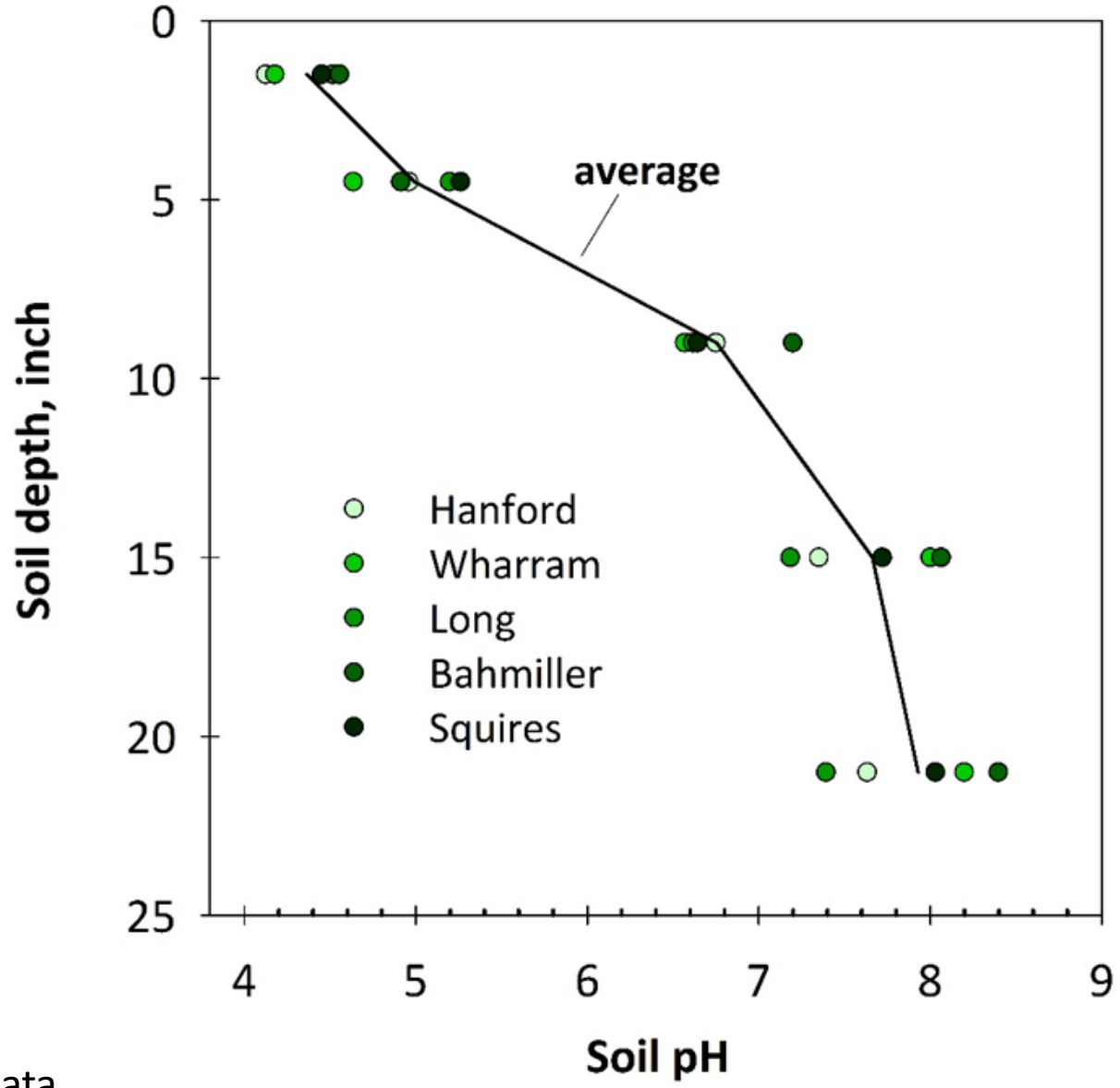
- Coarse soils (e.g. Big Sandy)
- Higher precipitation (e.g. Highwood Bench)
- Nitrate leaching (because less nitrate uptake and less root release of bases)
- Low organic matter
- Stubble removal
- No-till (because less subsoil mixing)

Avg. annual precip. 1971-2000





Chouteau County pH stratification in no-till fields



Engel, unpub. data

Management to prevent acidification

- Increase nitrogen fertilizer use efficiency
- Soil test close to application time
- Use conservative pre-plant rate, top-dress if adequate moisture
- Apply N close to peak crop uptake
- Plant lower N-needing crops, including pulses
- Plant perennial forages (NRCS has list of acid-tolerant varieties)
- Reduce N rates especially when protein discounts low
- Use variable, site specific rates:

  Apply less N in low pH areas – accelerates problem

  Less N in low production areas limited by other than N

- Change N source?
- Minimize use of ammonium fertilizers (11-52-0, 21-0-0-24)
- Use calcium ammonium nitrate ($$) instead of urea or UAN (CAN shouldn't volatilize so can likely also lower rate)
- Manure if available

Questions?

Image from Oregon State University, Lane County, OR 1926.

For more information see the 2 *Soil Scoops* on soil acidification and more presentations at MSU Soil Fertility website:
http://landresources.montana.edu/soilfertility/soilscoop.html

Eastern Oregon Liming Guide OSU EM9060, Soil Acidity in Oregon: Understanding and Using Concepts for Crop Production OSU EM9061
https://catalog.extension.oregonstate.edu/