

Crop Production Clinics

IRRIGATION WELL WATER: ESSENTIAL NUTRIENTS, LIME AND OTHER PROPERTIES

Charles Wortmann
Soil Management Specialist
UNL Department of Agronomy & Horticulture
cwortmann2@unl.edu



Essential nutrients

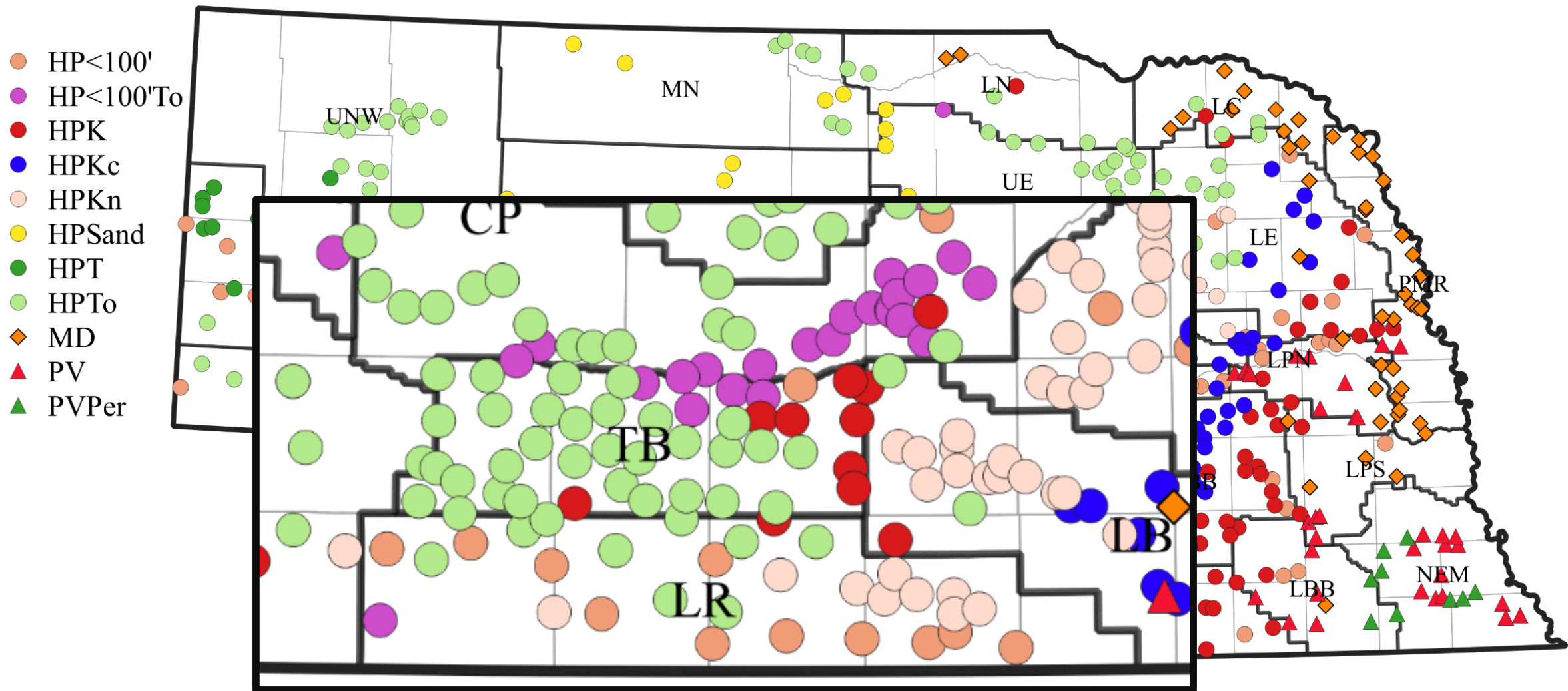
- CHOPKNS CAFE MG B MN CUZN MO CL, Ni
- CHO: carbon, hydrogen oxygen
- P phosphorus, K potassium, N nitrogen, S sulfur, Ca calcium, Fe iron, Mg magnesium, B boron, Mn manganese, Cu copper, Zn zinc, Mo molybdenum, Cl chloride, Ni nickel
- Liming and other properties

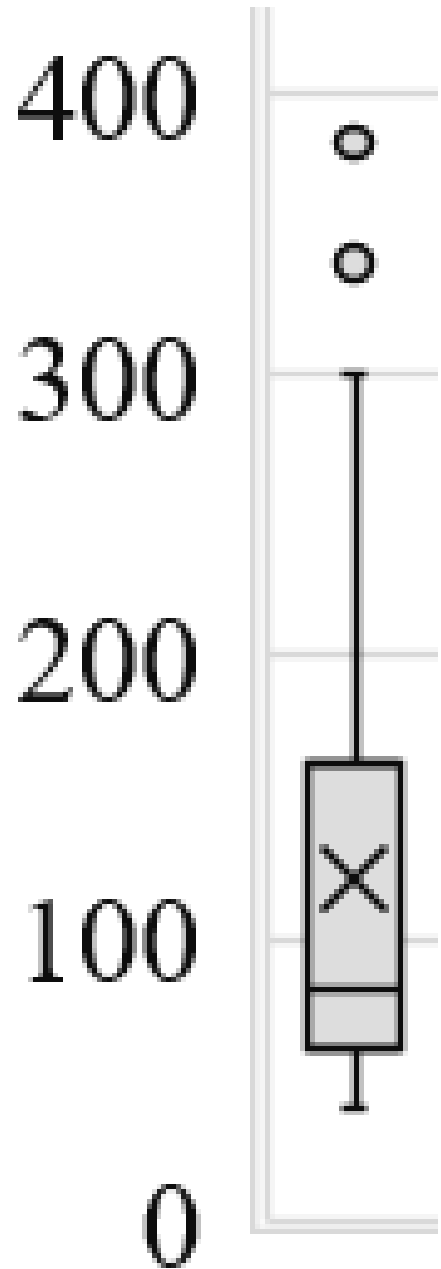


Highlights--statewide

- Water of 642 wells was sampled in 2020 (32 in LR; 55 in TB)
- Irrigation supply in 10 ac-in is > removal in 200 bu/ac of corn grain for:
 - 100% for Ca and Cl; 93% for Mg
 - 73% for S, 20% for K, 16% for Mn or Mo, 7% for B
 - Few for Zn, Cu, Fe; none for P
 - 70% of wells for liming to neutralize soil acidification with 200 lb fertilizer-N
- Most wells have < 4.4 ppm $\text{NO}_3\text{-N}$ but 25% have >10 ppm
- Relatively low nutrient & lime supply in Sandhills but high for wells of <100 ft depth

Sampled wells: 11 aquifers-geology-depth categories

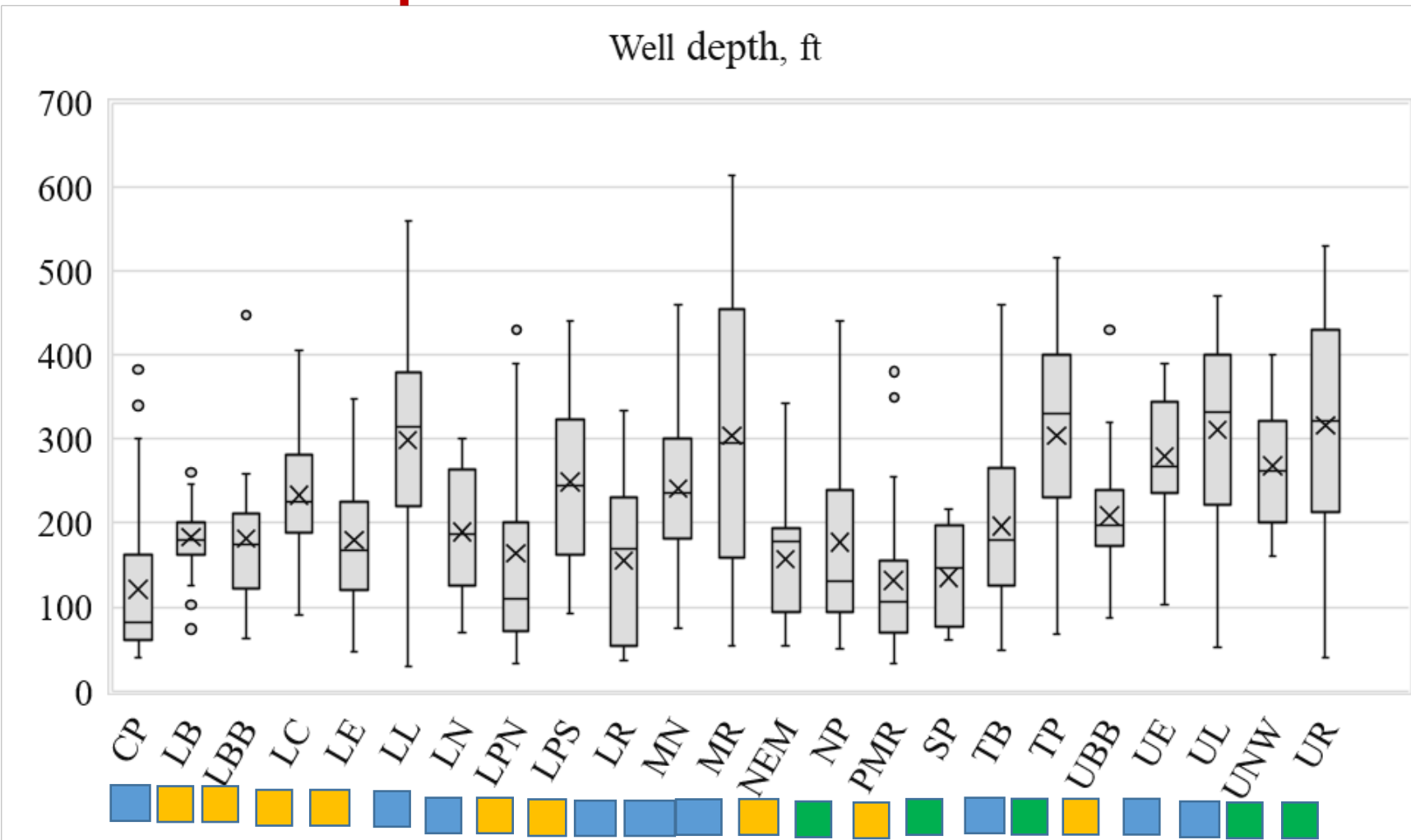




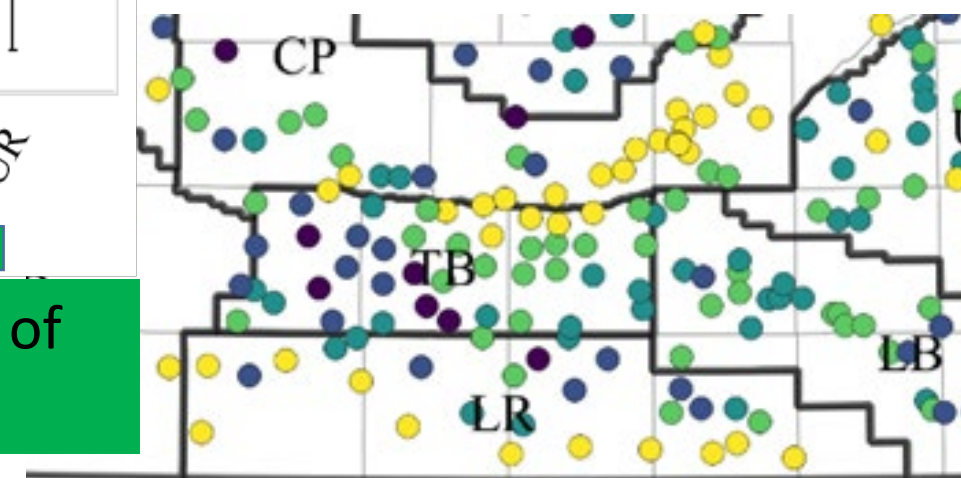
Whisker-box diagrams

1. 50% intermediate observations in box
2. 25% each in above and below whiskers
3. X is the average
4. Horizontal line in box is the median;
50% above and 50% below
5. Circles are considered outliers for the
NRD

Well depth



The shallow wells (yellow) were mostly in alluvial aquifers of the Platte and Republican.

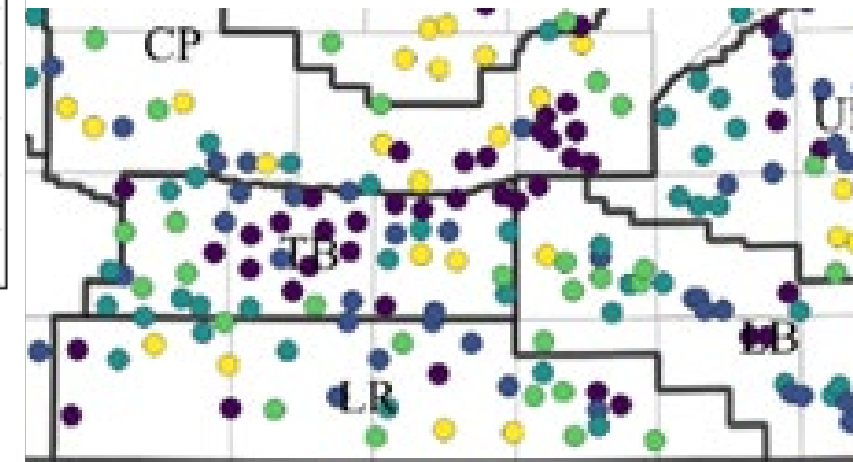
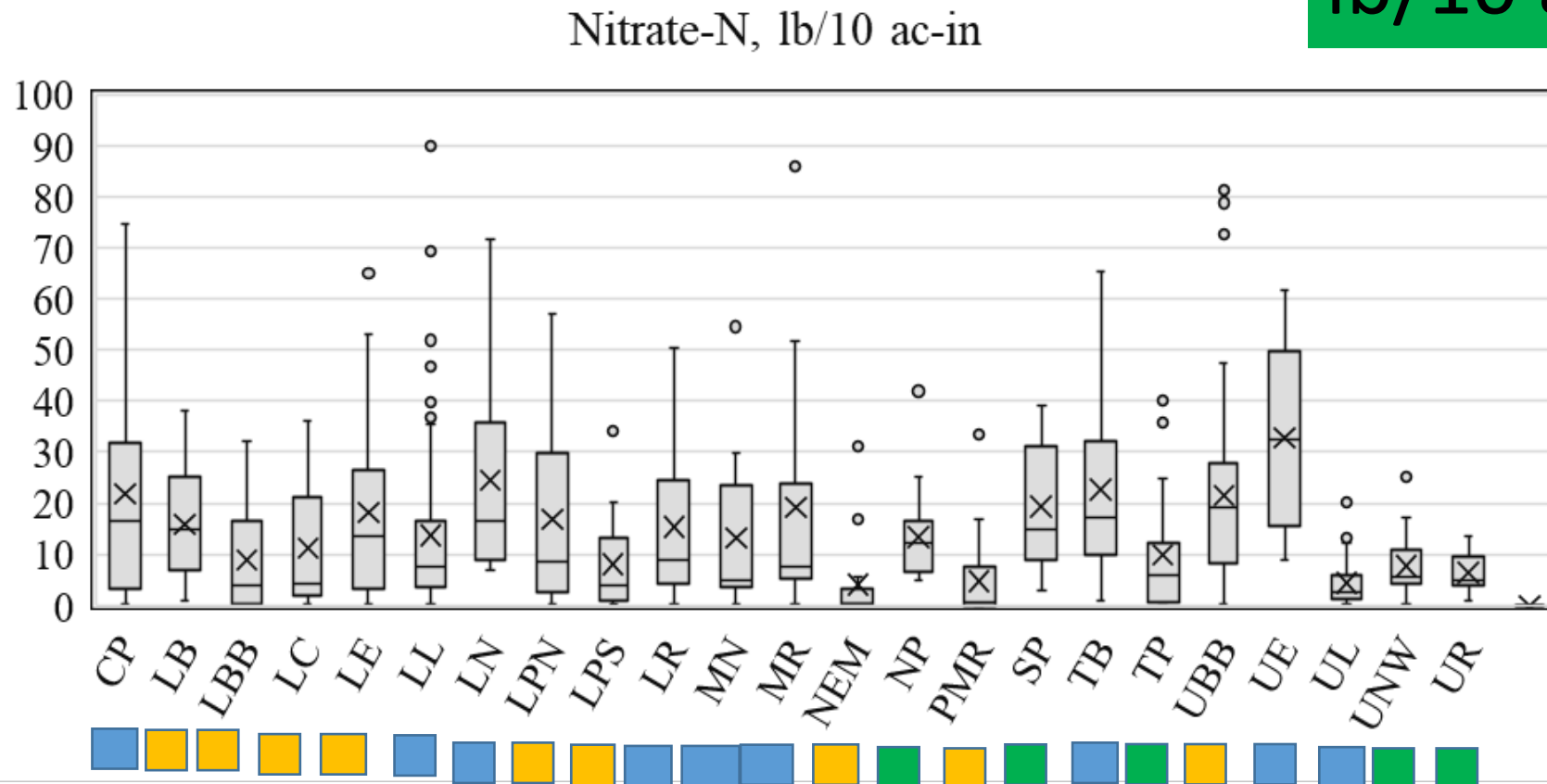


Nitrate-N (very little $\text{NH}_4\text{-N}$)

ppm x 2.265 =
lb/10 ac-in

Nitrate N, ppm

- < 1.3
- 1.3 - 2.8
- 2.8 - 6.0
- 6.0 - 11.5
- > 11.5



Medians, ppm: % > 10

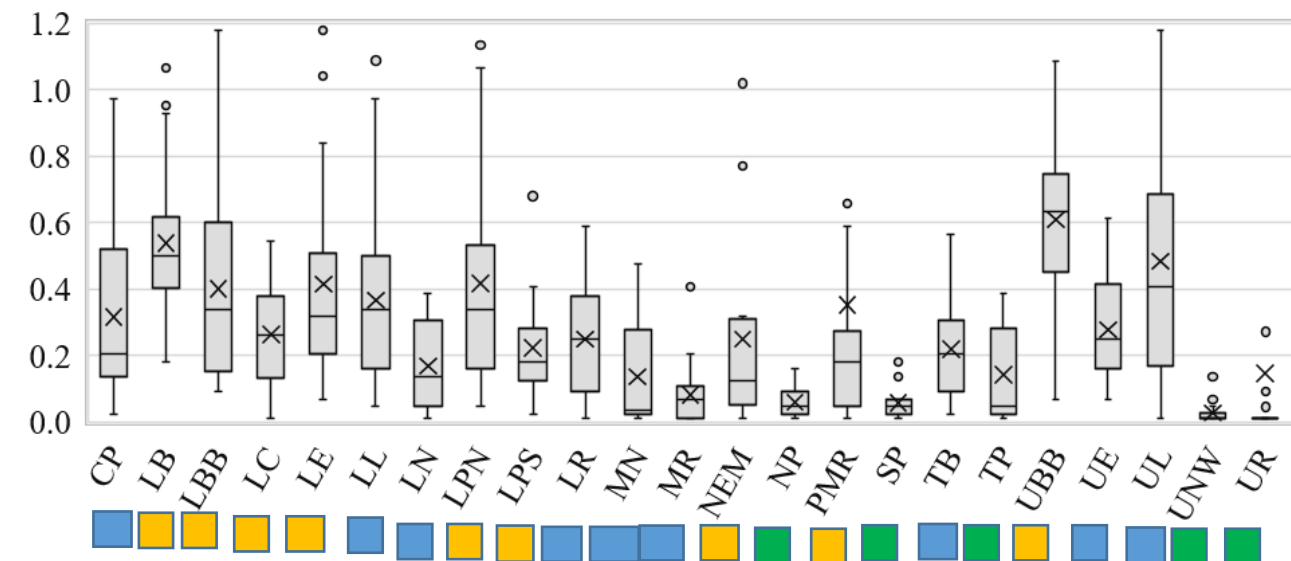
LR: 4.0; 34%

TB < 100' 21.6, 86%;

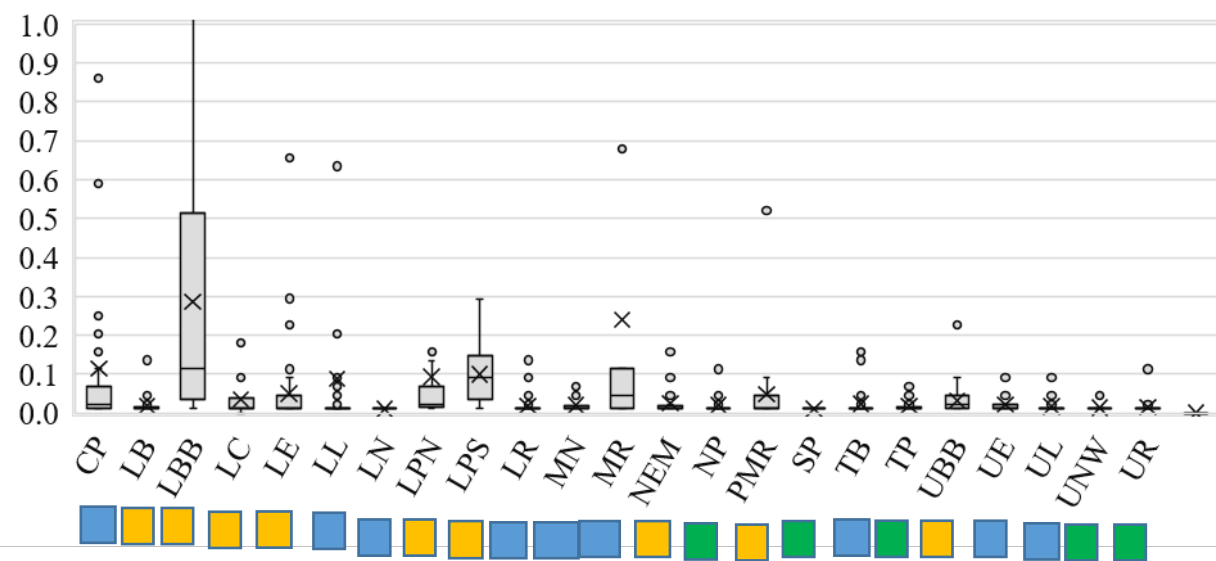
TB > 100' 6.6, 37%



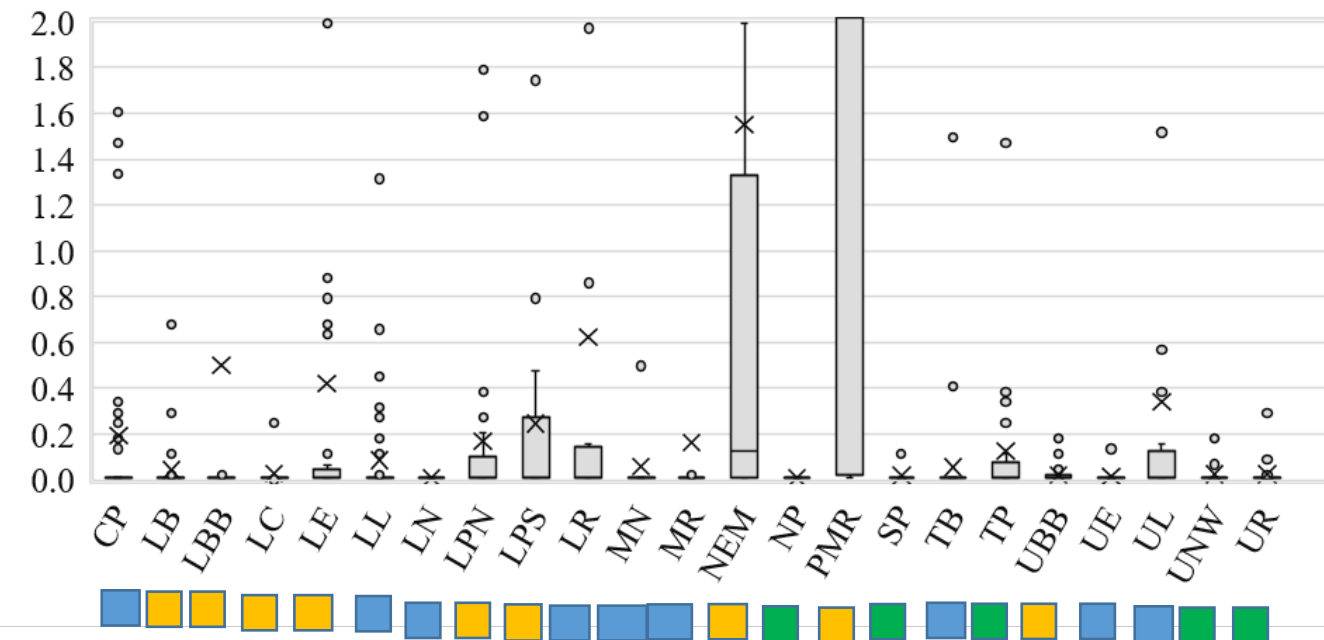
Phosphorus (P lb/10 ac-in; ~35.6 lb in 200 bu of corn grain)



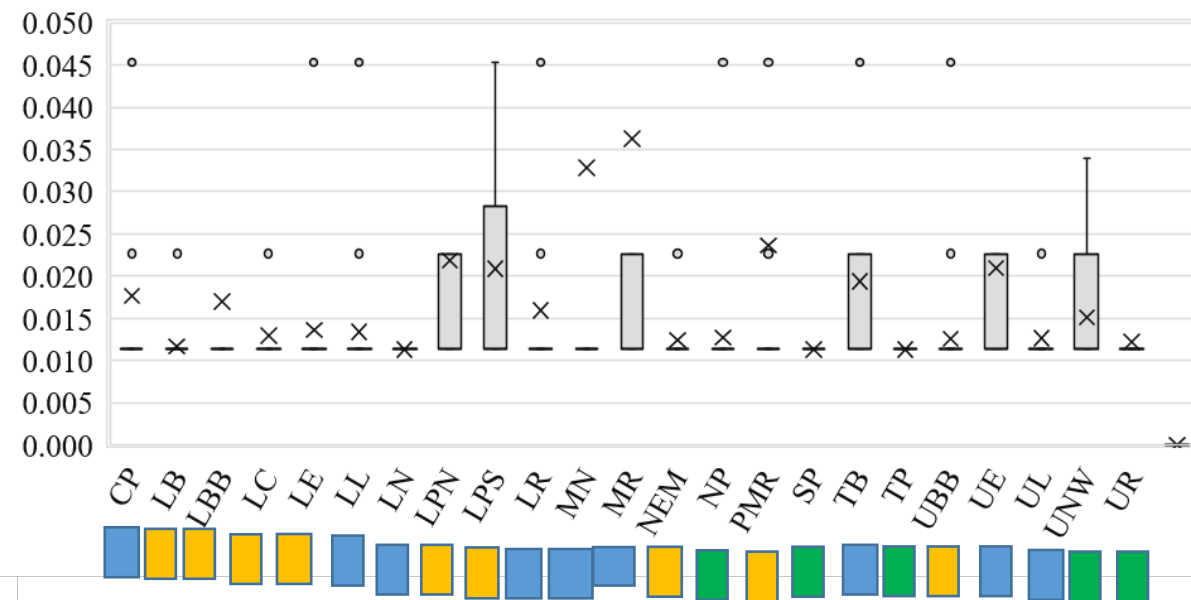
Zinc (Zn, lb/10 ac-in; ~0.17 lb in 200 bu of corn)



Iron (Fe, lb/10 ac-in; ~0.43 lb in 200 bu of corn)



Copper (Cu, lb/10 ac-in; ~0.014 lb in 200 bu of corn)



Manganese (Mn, lb/10 ac-in; ~0.047 lb in 200 bu of corn)

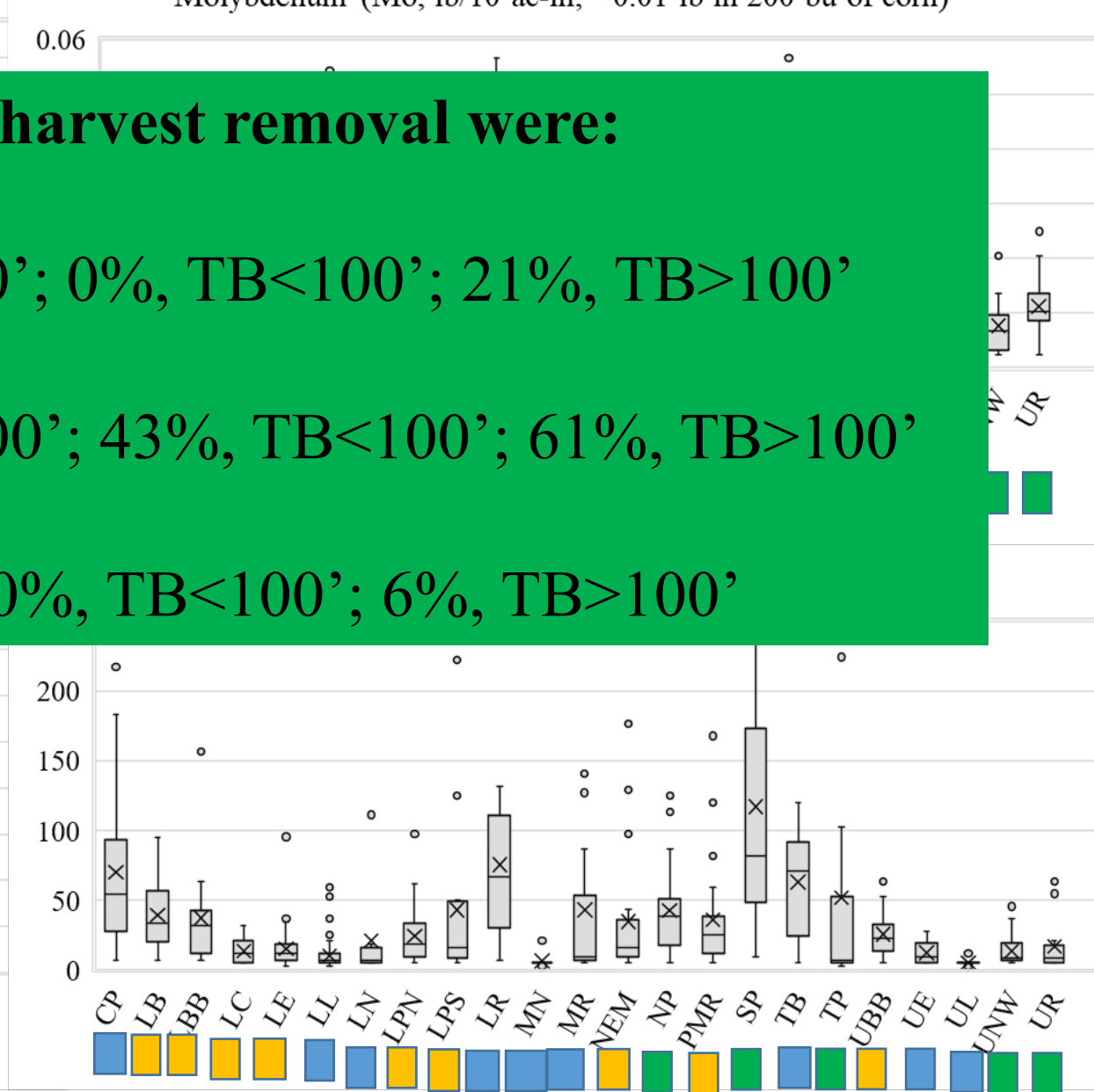
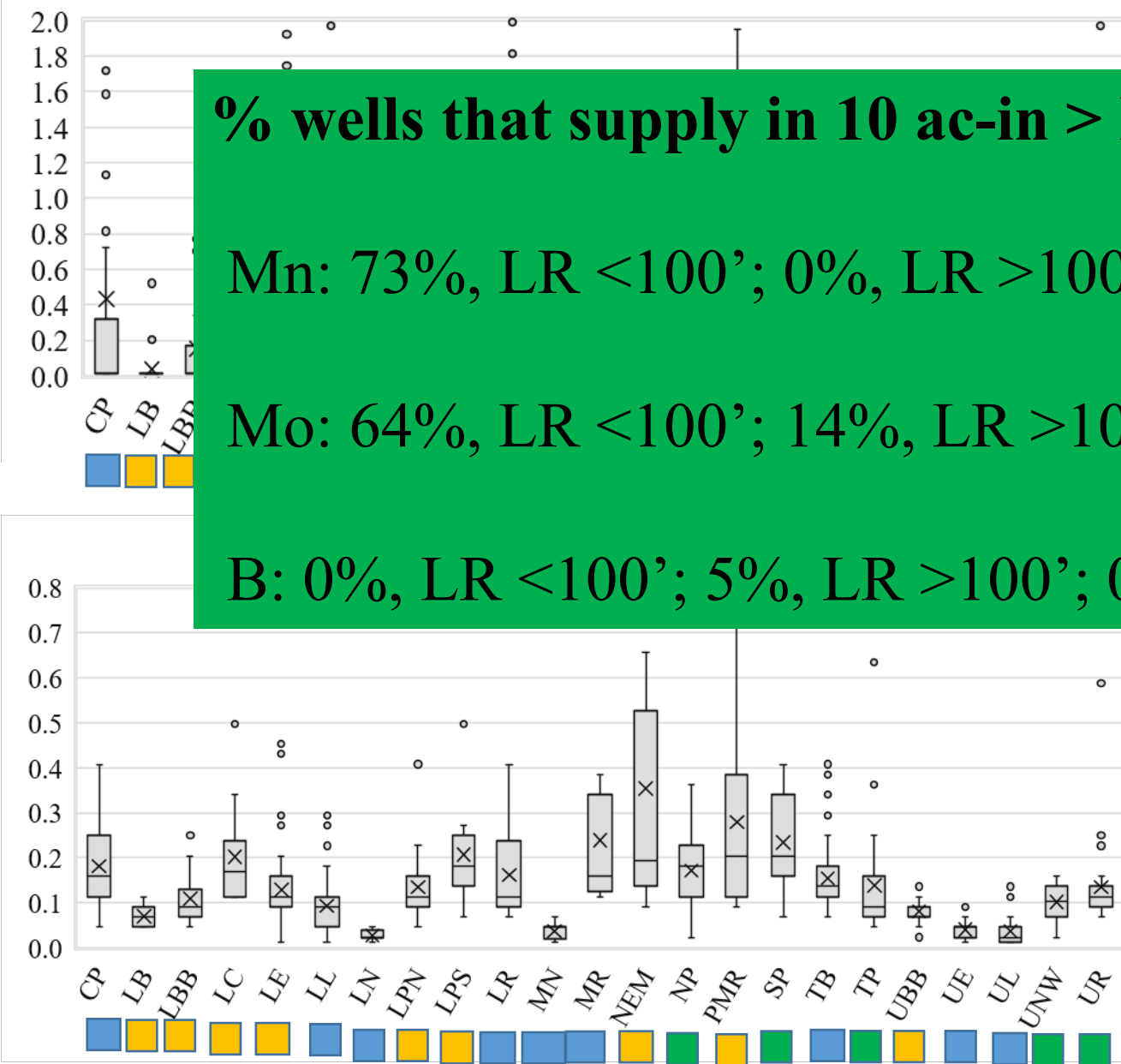
Molybdenum (Mo, lb/10 ac-in; ~0.01 lb in 200 bu of corn)

% wells that supply in 10 ac-in > harvest removal were:

Mn: 73%, LR <100'; 0%, LR >100'; 0%, TB<100'; 21%, TB>100'

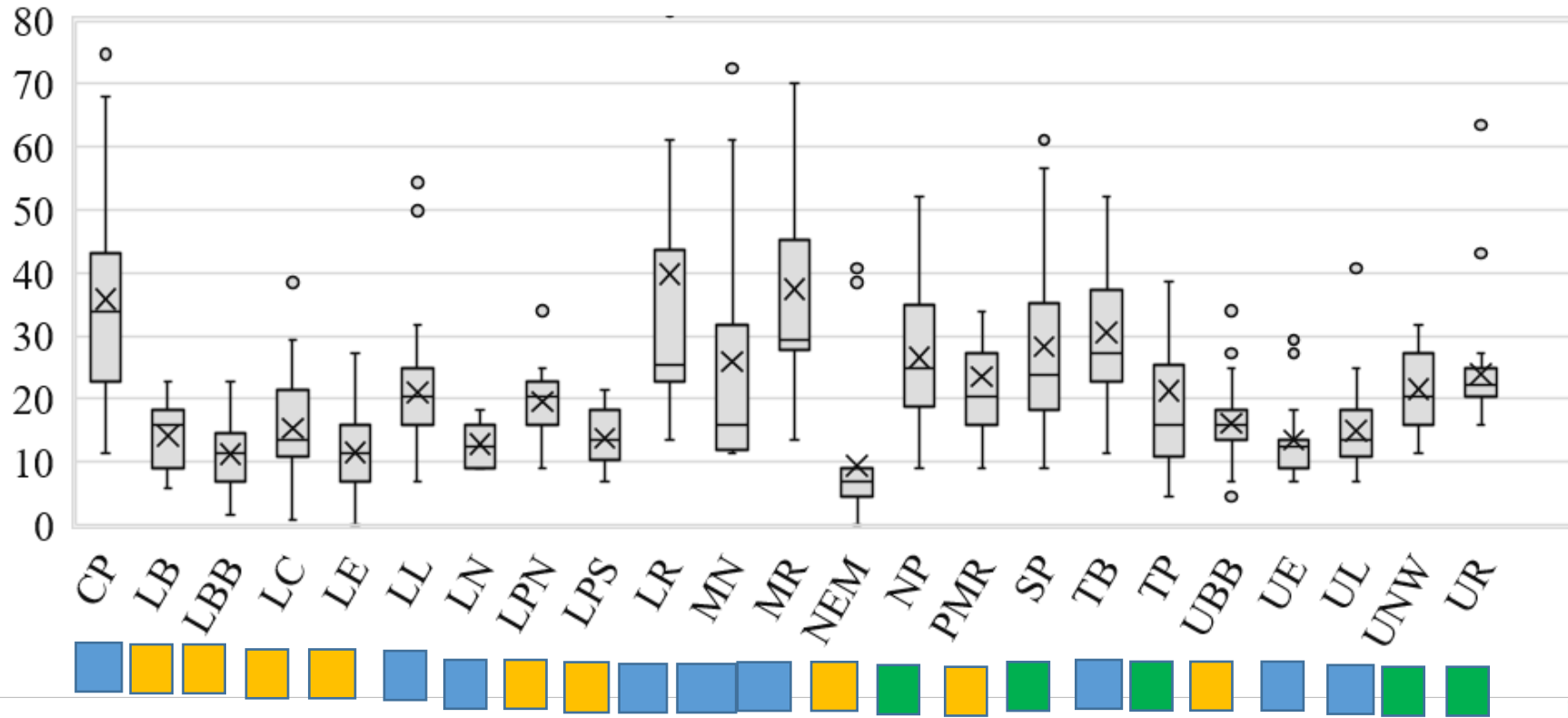
Mo: 64%, LR <100'; 14%, LR >100'; 43%, TB<100'; 61%, TB>100'

B: 0%, LR <100'; 5%, LR >100'; 0%, TB<100'; 6%, TB>100'



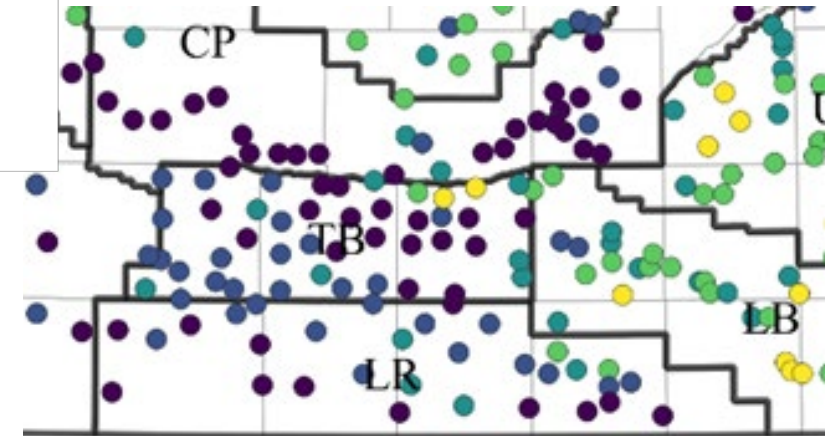
Potassium

Potassium (K, lb/10 ac-in; ~28.4 lb/200 bu of corn)



Potassium, ppm

- < 5
- 5 - 7
- 7 - 9
- 9 - 13
- > 13



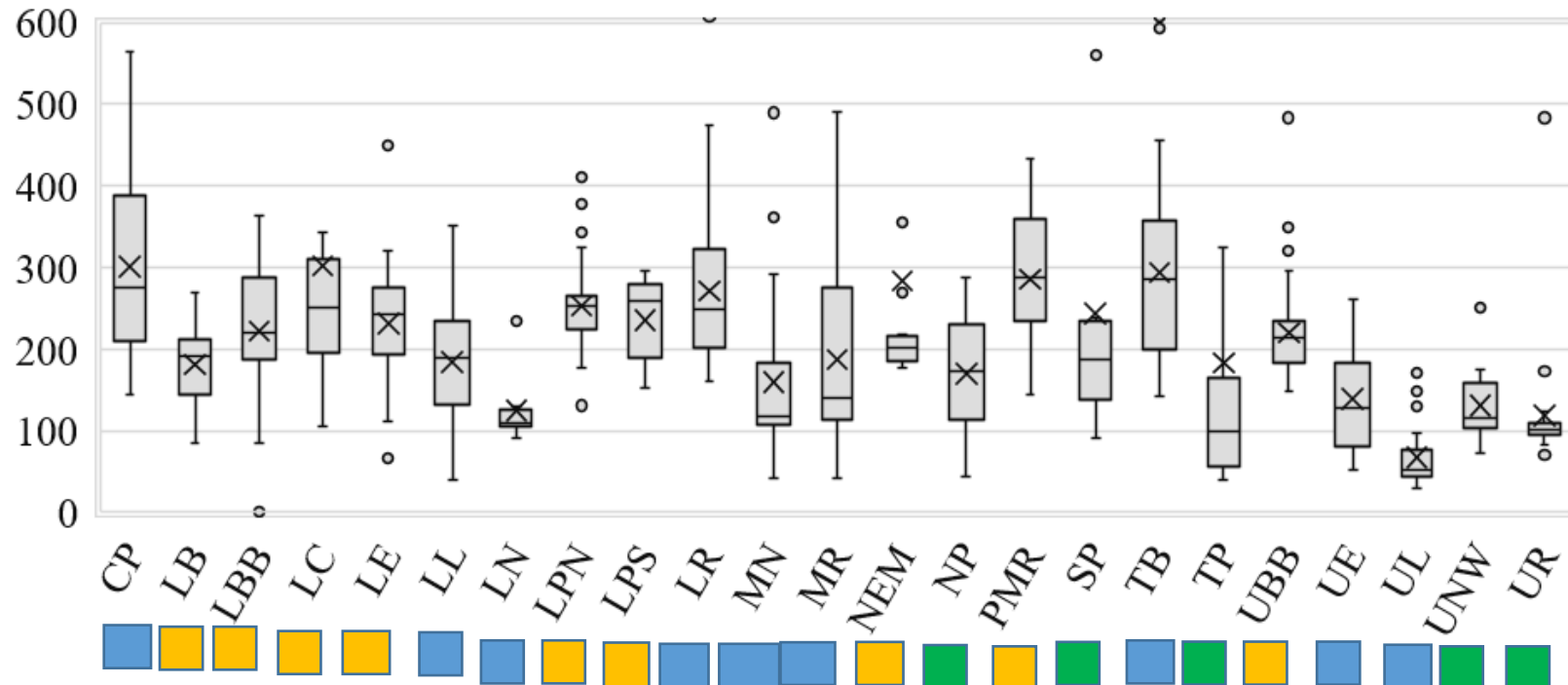
>28.4 lb K in 10 ac-in:

91%, LR<100'; 19%, LR>100';

43%, TB<100'; 50%, TB>100'

Calcium and Magnesium

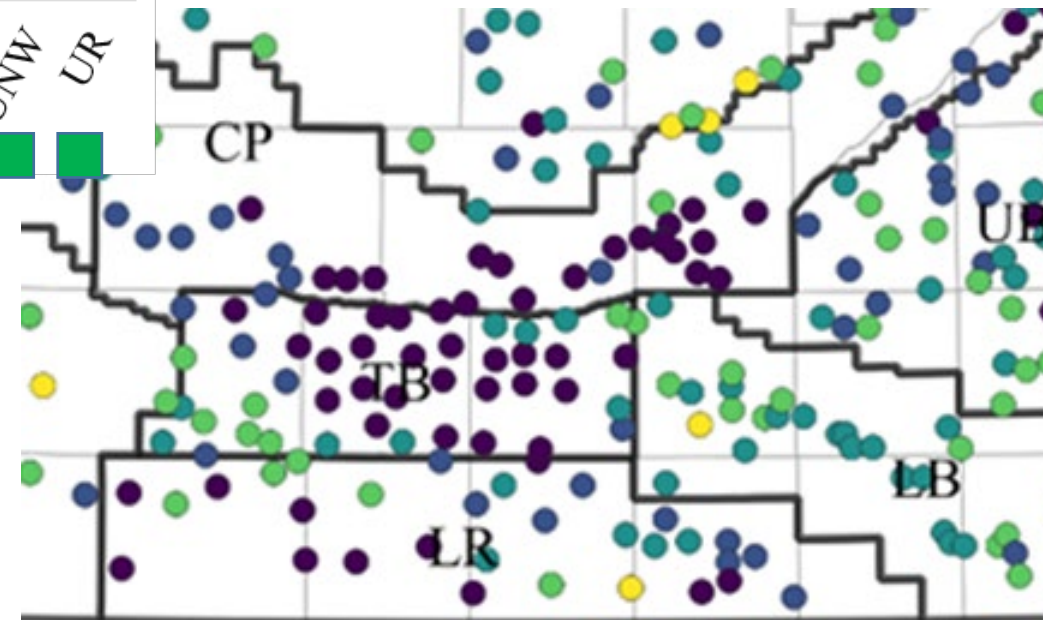
Calcium (Ca, lb/10 ac-in; ~2.6 lb Ca in 200 bu of corn)



Calcium, ppm

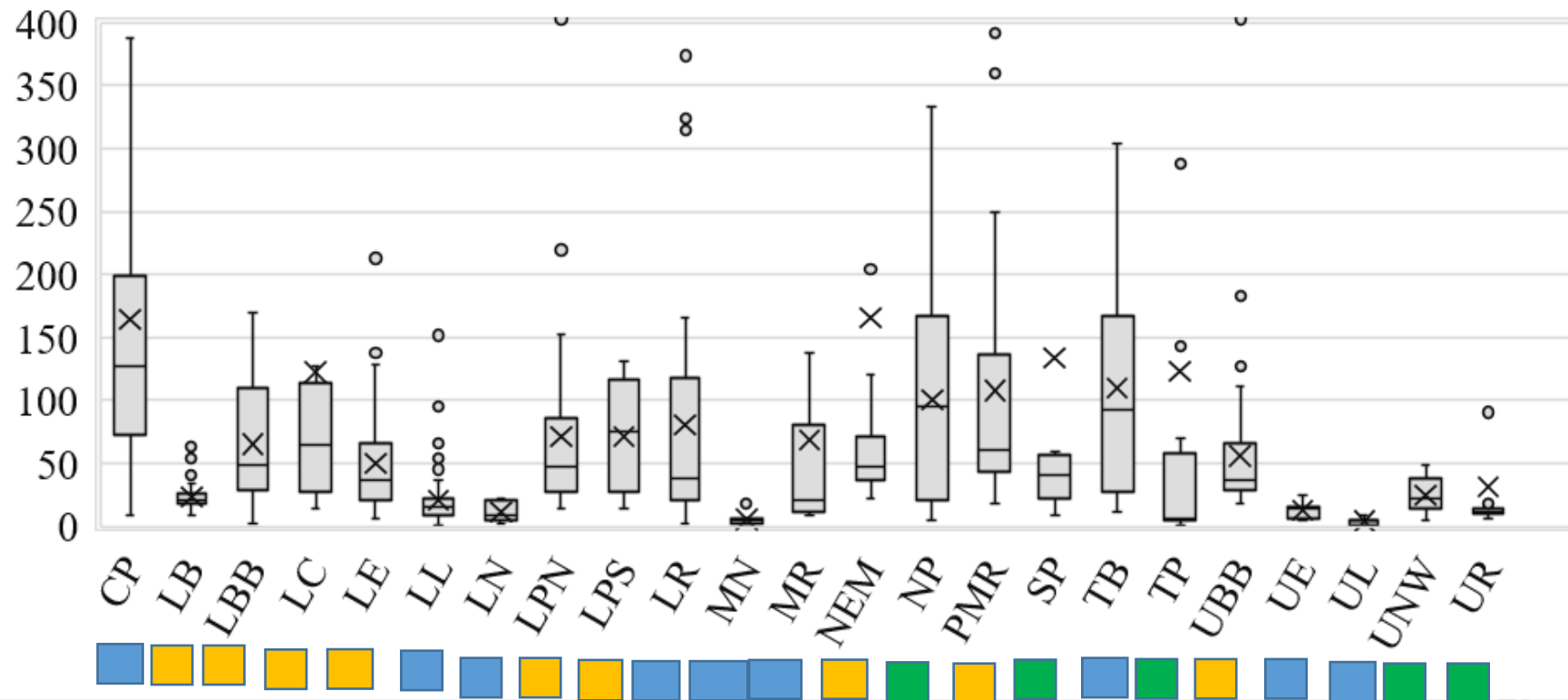
- < 52
- 52 - 80
- 80 - 98
- 98 - 122
- > 122

All LR and TB wells supplied in 10 ac-in more Ca & Mg than removed in 200 bu corn grain



Sulfur

Sulfur (S, lb/10 ac-in; ~ 13.6 lb in 200 bu of corn)



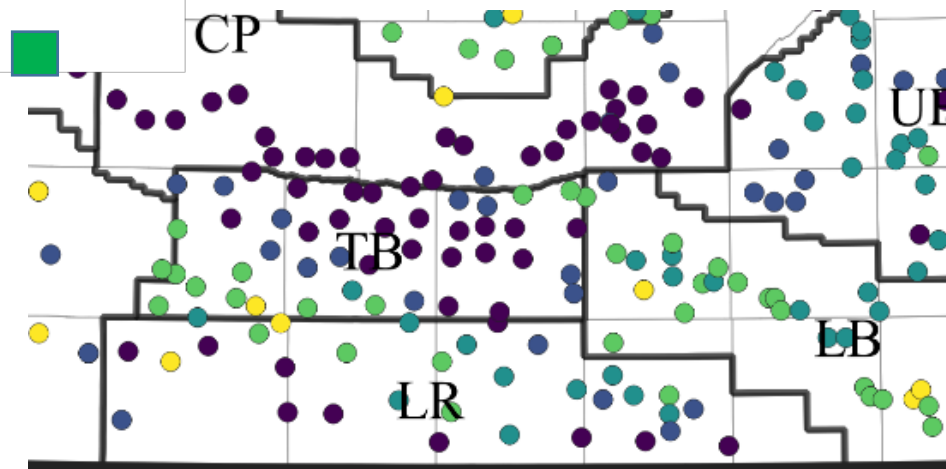
Sulfur, ppm

- 0.5 - 5
- 5 - 10
- 10 - 18
- 18 - 43
- 43 - 729.3

>13.6 lb S in 10 ac-in:

91%, LR<100'; 95%, LR>100';

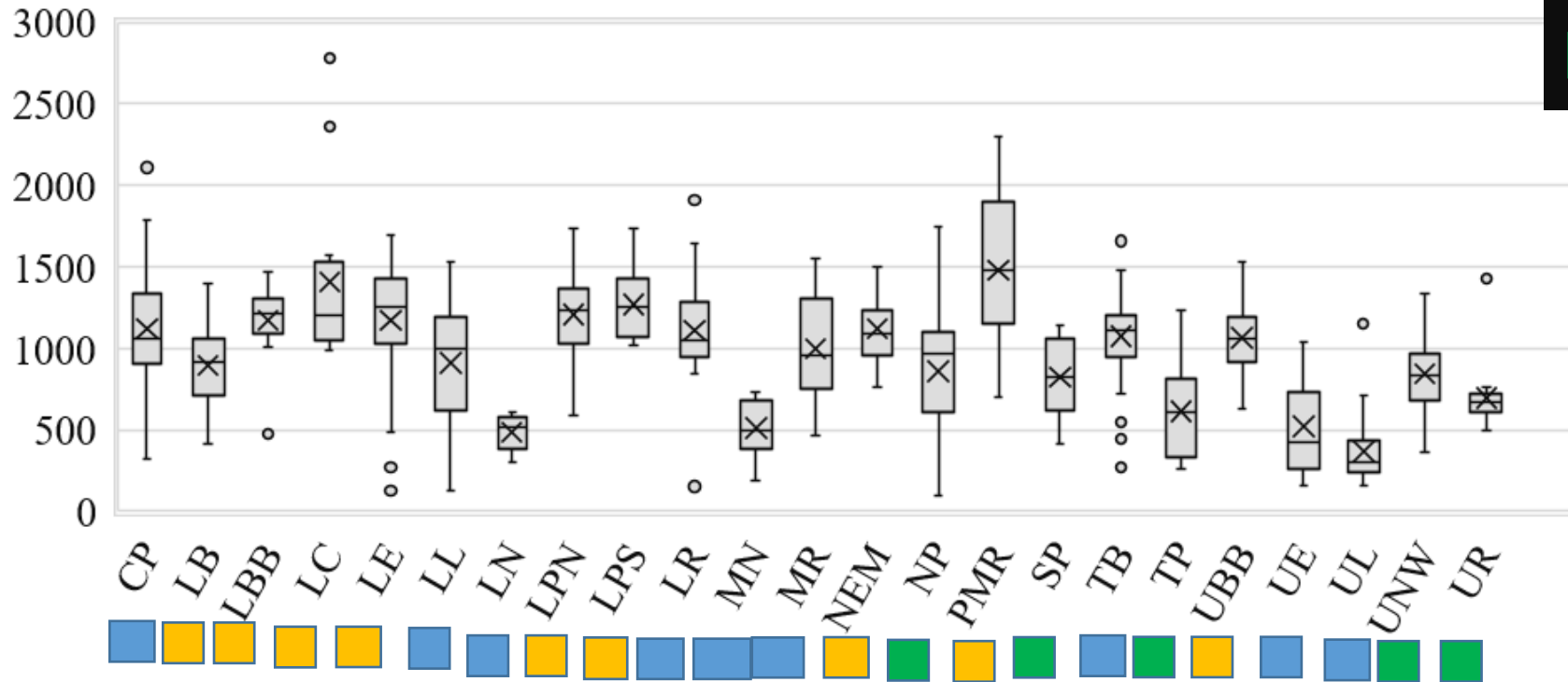
100%, TB<100'; 97%, TB>100'



Bicarbonate and ag lime equivalent

340 lb of agricultural lime neutralizes the acidification effect of 200 lb of fertilizer-N.

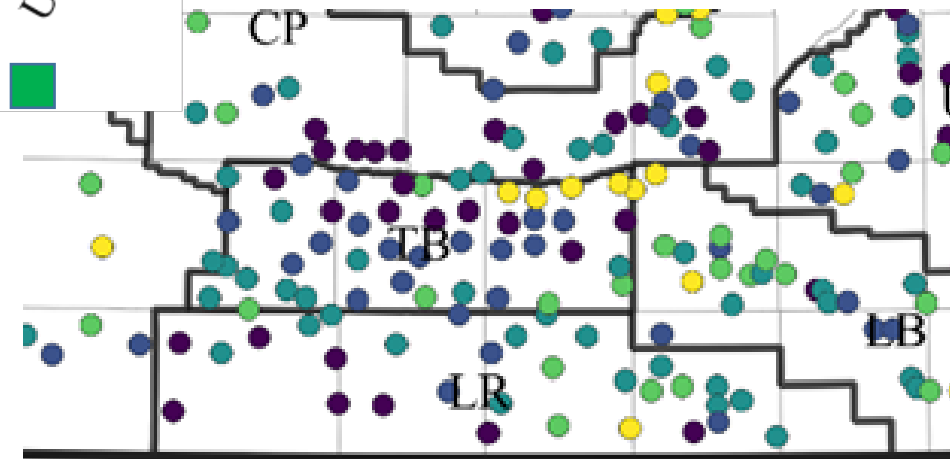
Agricultural lime equivalent (lb/10 ac-in)



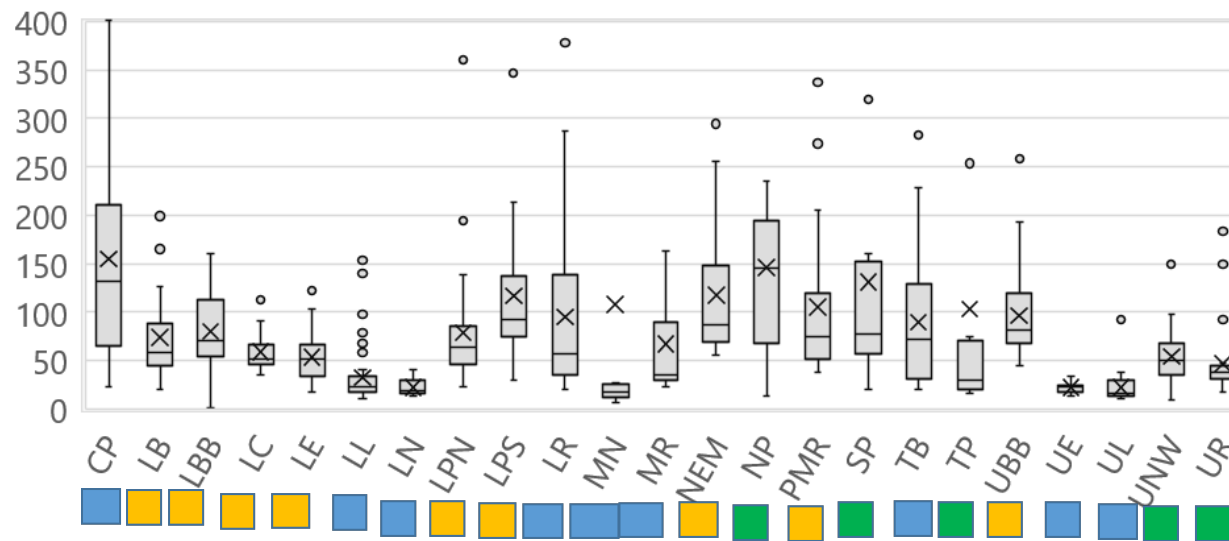
HCO₃, ppm

- < 206
- 206 - 294
- 294 - 351
- 351 - 418
- > 418

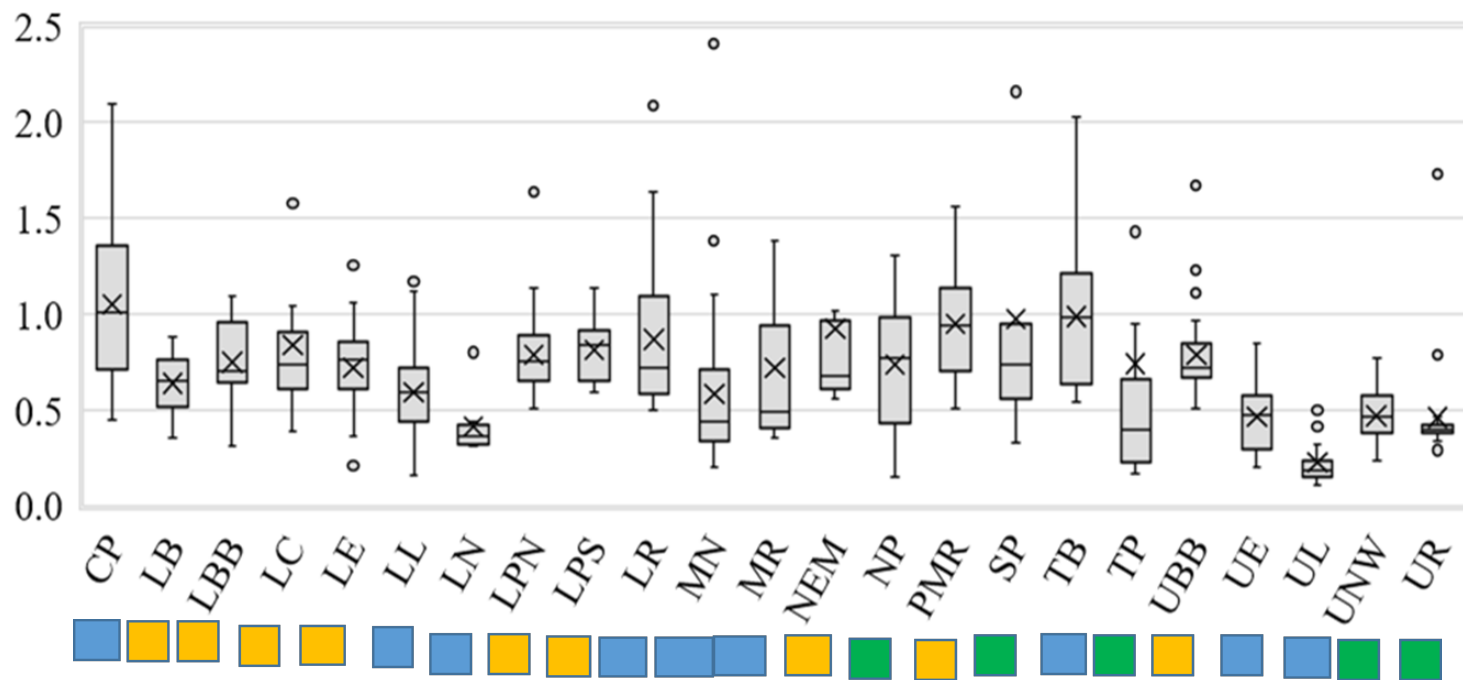
The liming effect of 10 ac-in was
>340 lb ag lime for:
91%, LR<100'; 100%, LR>100';
43%, TB<100'; 95%, TB>100'



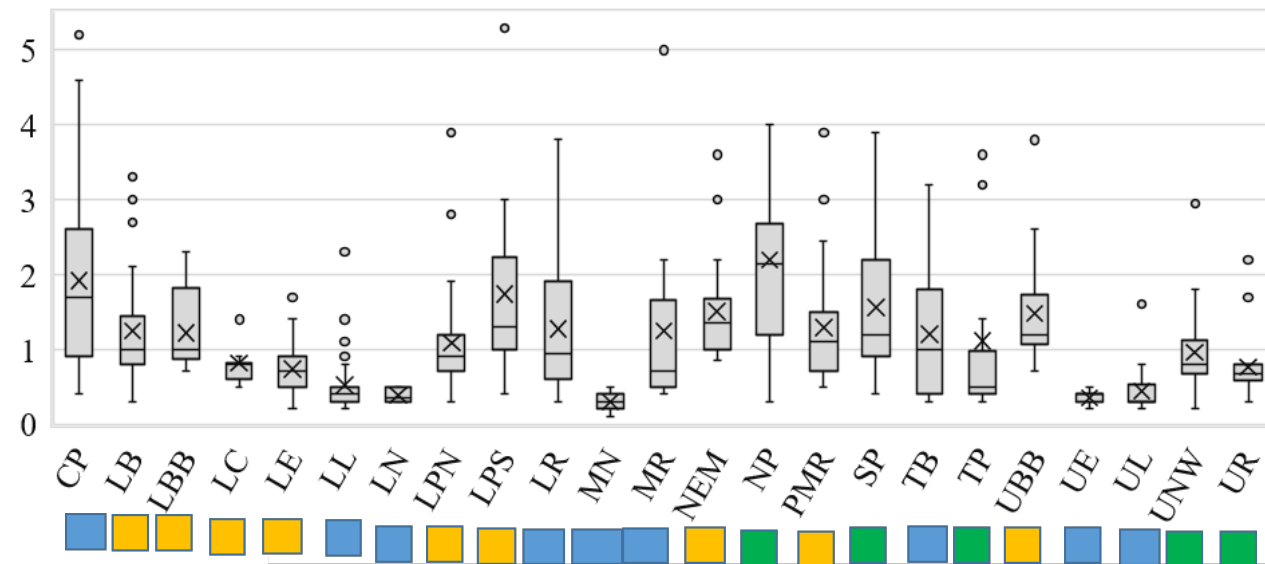
Sodium (Na, lb/10 ac-in)



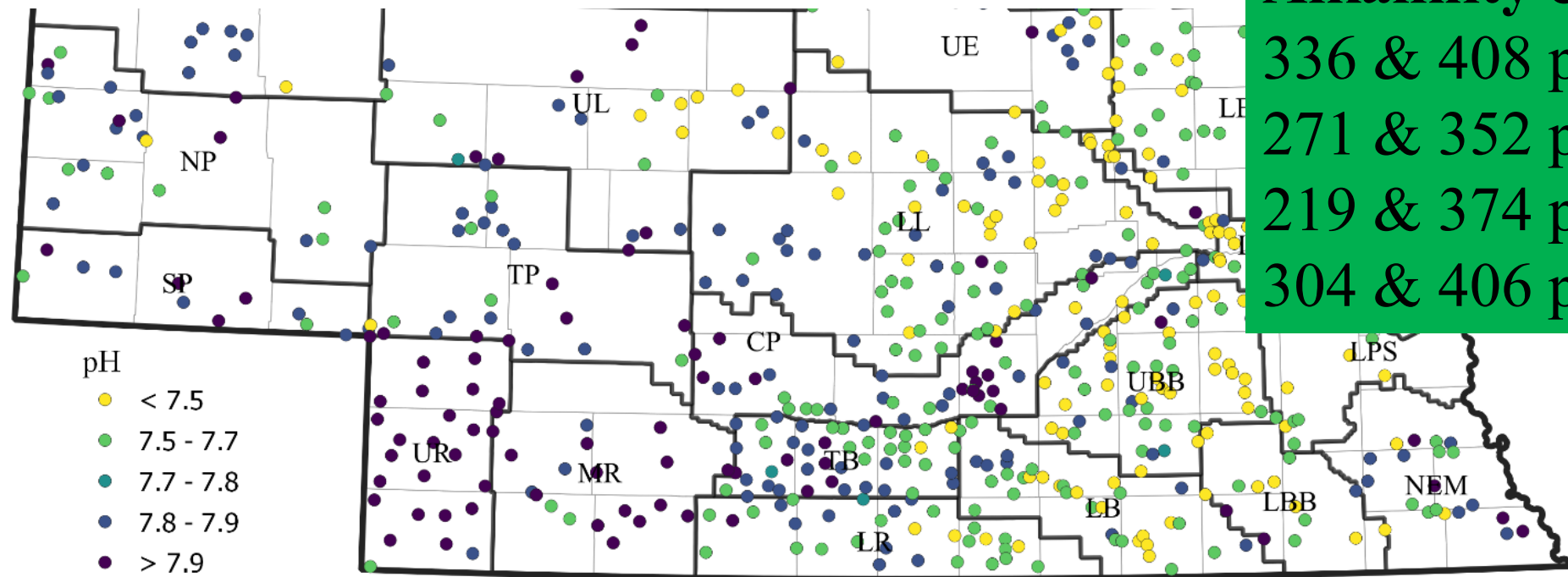
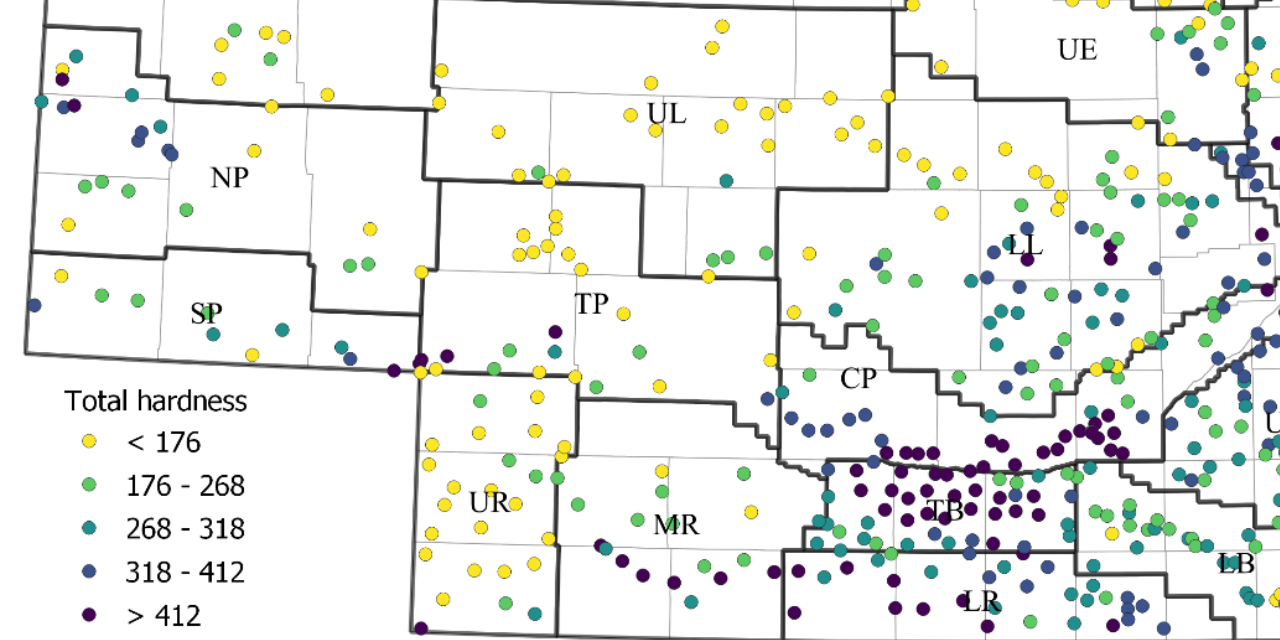
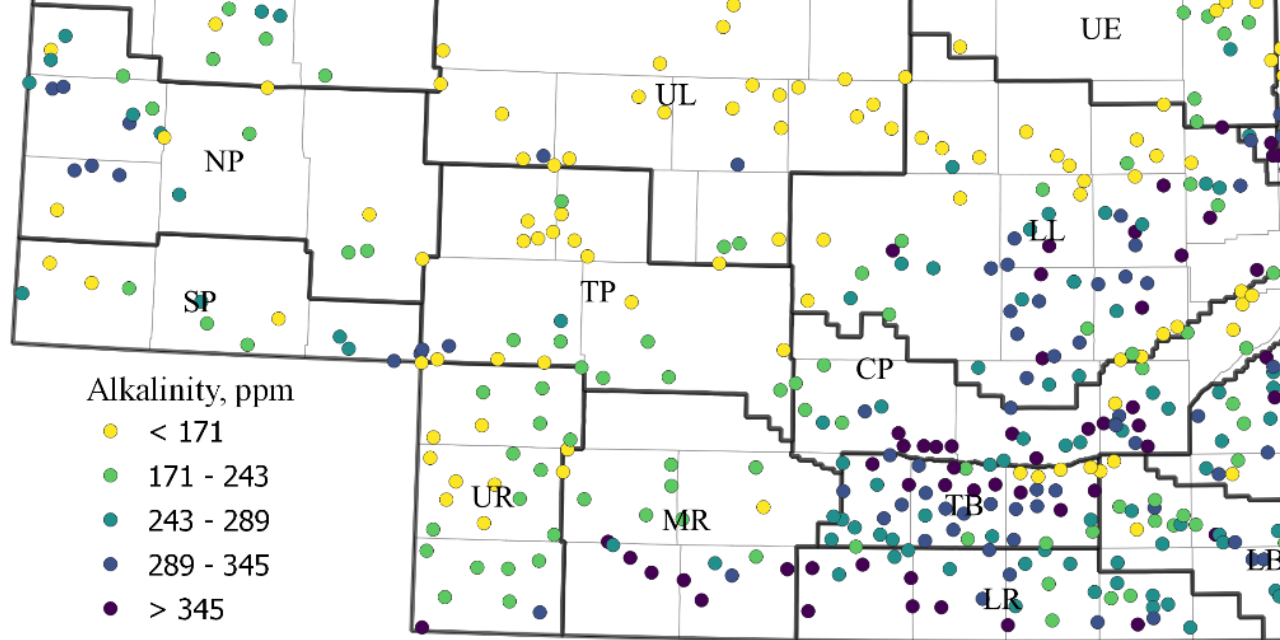
Electrical conductivity (EC, dS/m)



Sodium adsorption ratio (SAR), adjusted



No sampled wells
had problematic
SAR or salinity.



Alkalinity & hardness were:
 336 & 408 ppm, LR<100';
 271 & 352 ppm, LR>100';
 219 & 374 ppm, TB<100';
 304 & 406 ppm, TB>100'

Conclusions

- Irrigation supply in 10 ac-in > removal in 200 bu/ac of corn grain for:
 - Ca, Mg and Cl with 100% of wells
 - S 96%; K 48%, Mn 21%, Mo 47%
 - B, Zn, Cu, Fe with few wells
 - liming neutralizes acidification by 200 lb of fertilizer-N for 91% of wells
- Most wells have < 6.9 ppm NO₃-N but 40% >10 ppm
- Nutrient and lime supply for well of <100' compared with >100' depth was generally greater for LR but less for TB (except for nitrate-N) wells.

Conclusions

- Salinity and sodium of little concern
- Patterns of high vs low concentrations but much variation in short distances; therefore test well water (15? yr) to optimize nutrient & soil mngt
- Use both water and soil test information to decide on fertilizer and lime use according to UNL guidelines.

Watch for detailed reporting in an
Extension Circular

Data set: doi:10.5061/dryad.d7wm37q0k

Thank you

Questions or comments?