Subsoil quality in no-till winter wheat and spring canola

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REACCH
Regional Approaches to Climate Change – PACIFIC NORTHWEST AGRICULTURE

Climate Change, Precipitation, and Soil

- Changes in climate are causing changes in precipitation
  - Early snowmelt, wetter springs, drier summer
    - Less water available during summer
    - Dry top soil = weaker soil structure = erosion = loss of top soil and its nutrients
- Greater reliance on subsoil water and nutrients
  - Limited testing of subsoil
  - Many factors that can physically impede root growth
  - Overall availability of essential nutrients

Past Research

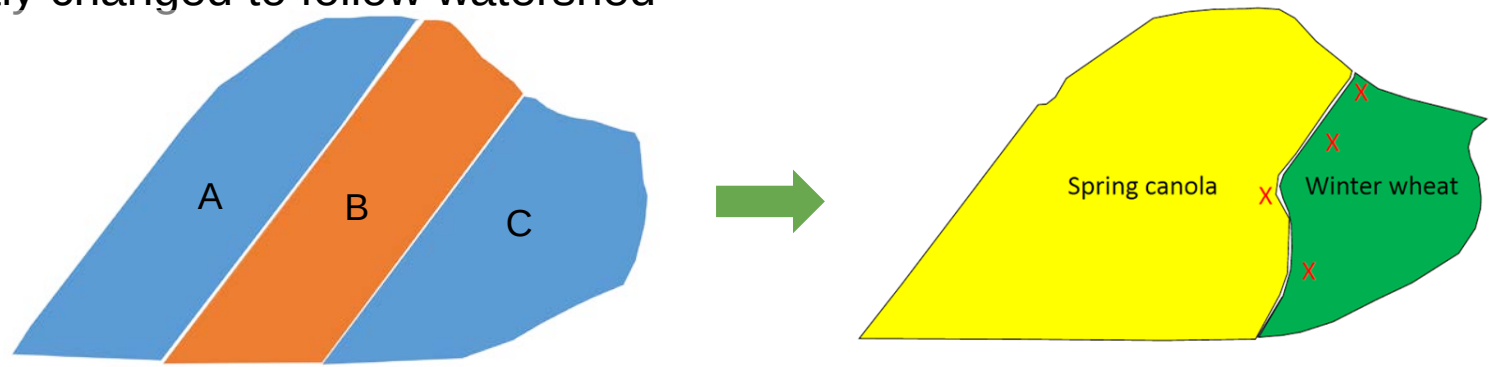
- Soil compaction in winter canola in different rainfall zones
  - Impact on root growth
  - Nutrient availability
- Soil management practices in winter wheat
  - Compared native, no till, and conventional till soil
  - Impact of drying and physical impedance on root growth
  - Nutrient availability and use
- Results
  - Low precipitation = severe compaction
  - Physical resistance from soil did inhibit root growth
  - Less severe compaction in no till
  - Nutrient availability differed among management practices, but soils were generally deficient in immobile nutrients

Research Questions

- What is the availability of nutrients to the crops?
  - Does this differ by location and soil type?
- Are there any correlations between root density and subsoil nutrients?
  - Does this differ by location and soil type?

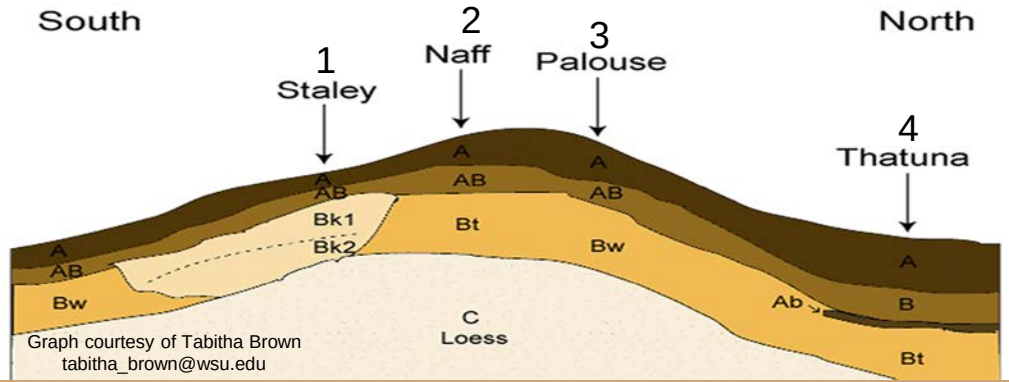
R.J. Cook Agronomy Farm

- High rainfall zone
- No till for 18 yrs
- Separated into 3 fields (A, B, and C) to represent a different stage in the crop rotation
  - Winter wheat, spring wheat, and a spring alternative crop
- Recently changed to follow watershed



Pit Sites

- 4 soil pit
  - Pit 1: winter wheat, Staley soil
    - Growth stage: feekes 11 - ripening
  - Pit 2: spring canola, Naff soil
    - Growth stage: 67 - flowering declining
  - Pit 3: winter wheat, Palouse soil
    - Growth stage: feekes 10.5 - heading complete
  - Pit 4: winter wheat, Thatuna soil
    - Growth stage: feekes 10.5 - heading complete



Graph courtesy of Tabitha Brown
tabitha_brown@wsu.edu

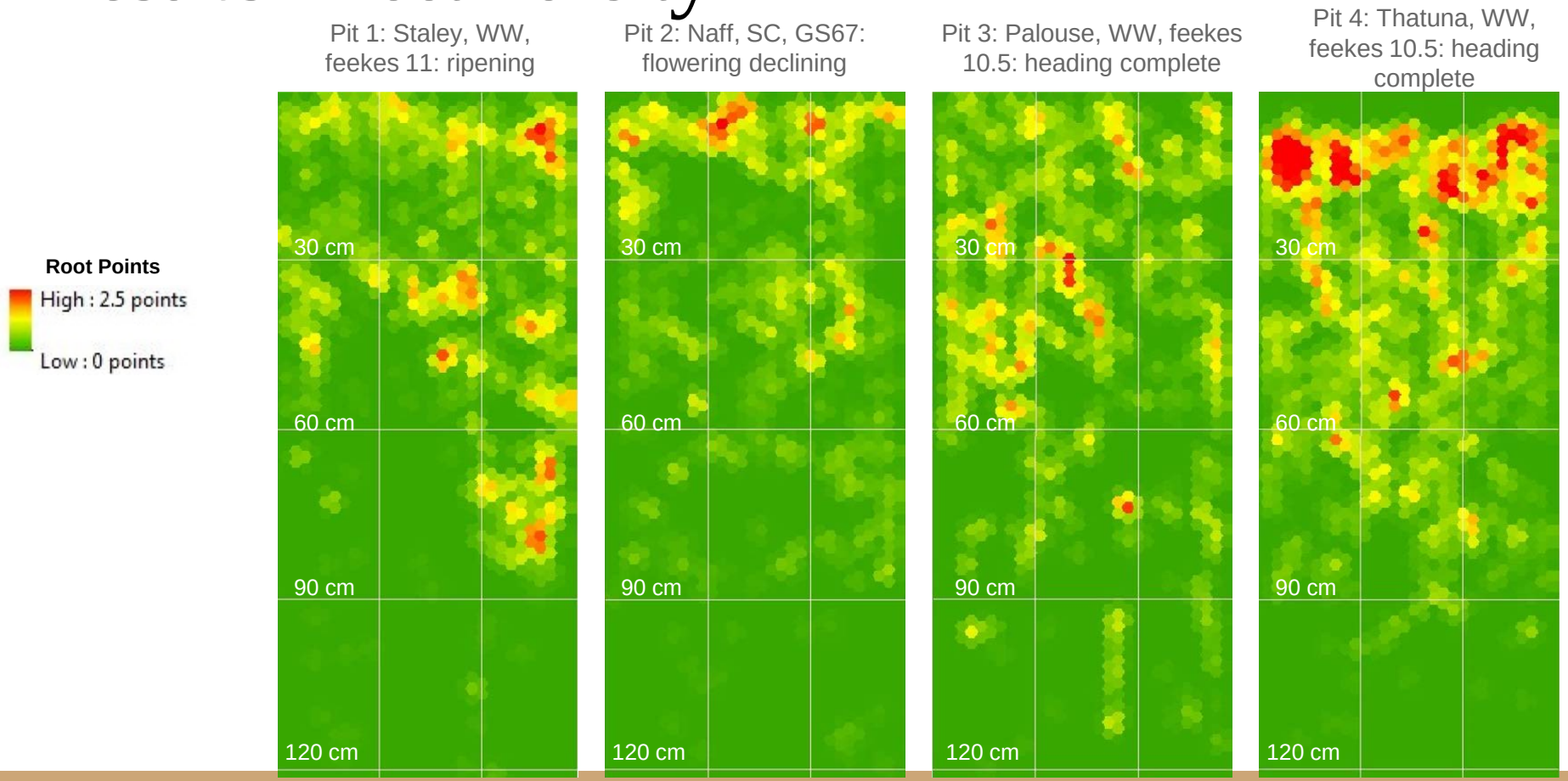
Methodology - Root Tracing

- Dug 1ft. space into side of pit
- Cleaned off face
- 21in. X 48 in. plexiglass in wooden frame
- Roots marked on plexiglass
- Root density calculated using ArcGIS

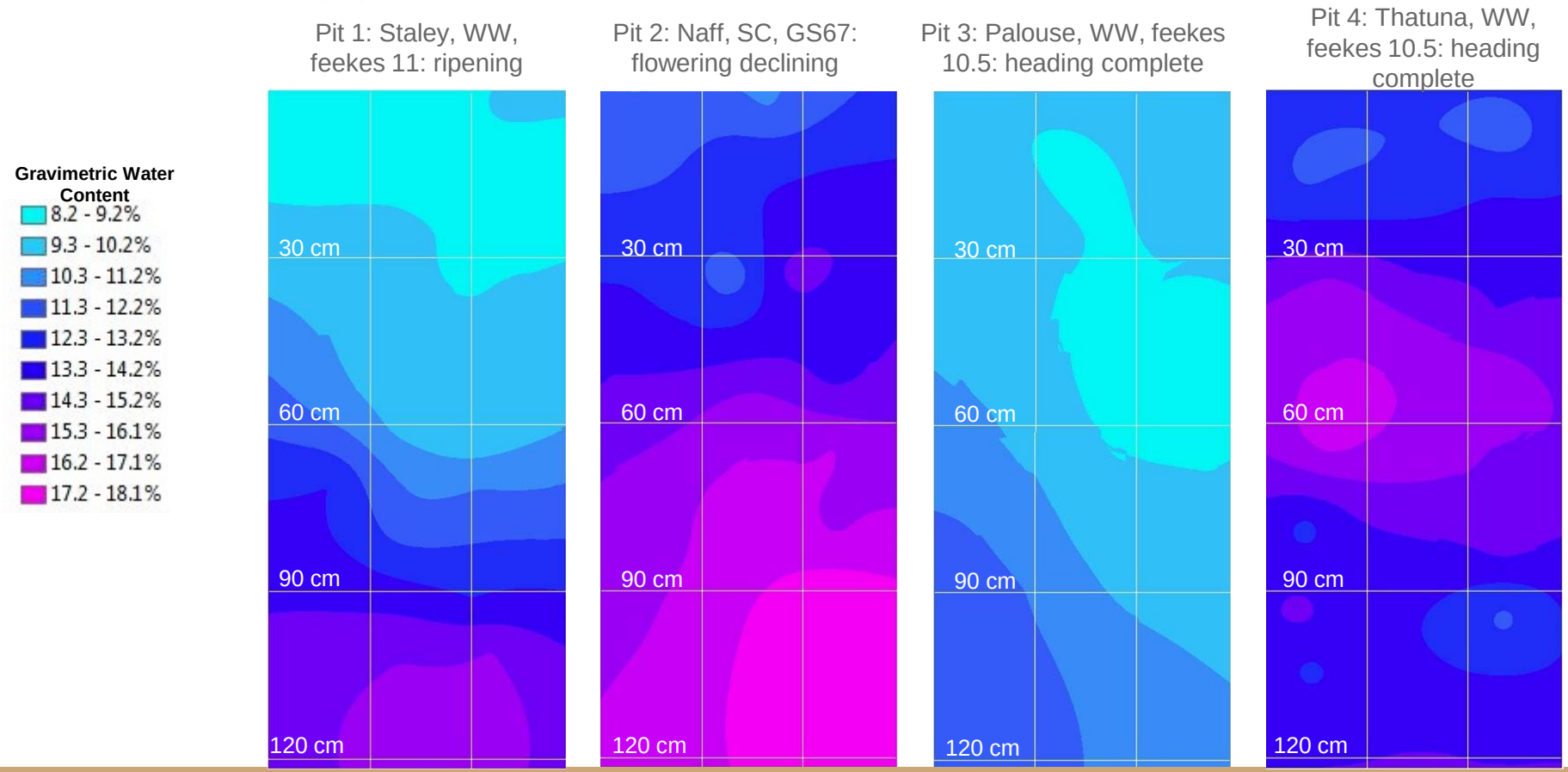
Methodology - Collecting Samples

- 21 samples per pit
  - 7 left, 7 right, 7 random
- Samples sent for chemical analysis
- Nutrient distribution maps made with ArcGIS
  - Interpolated using Kriging

Results - Root Density

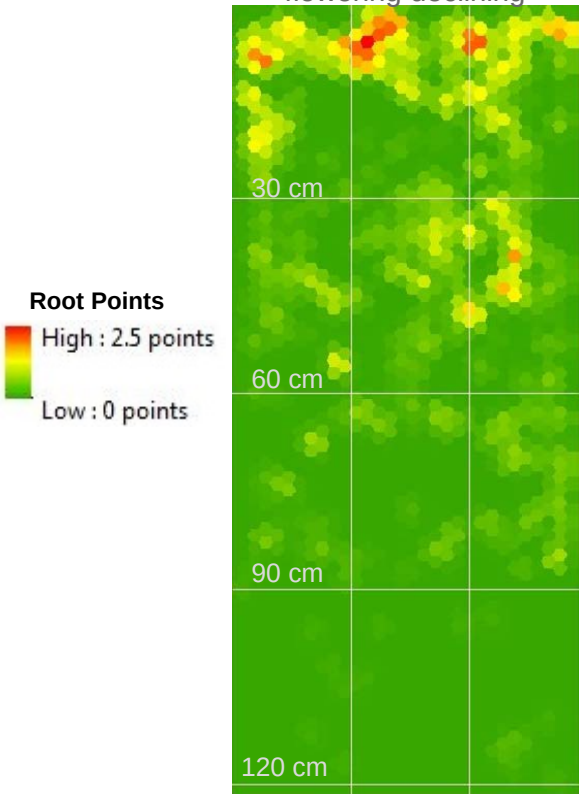


Results - Water Content

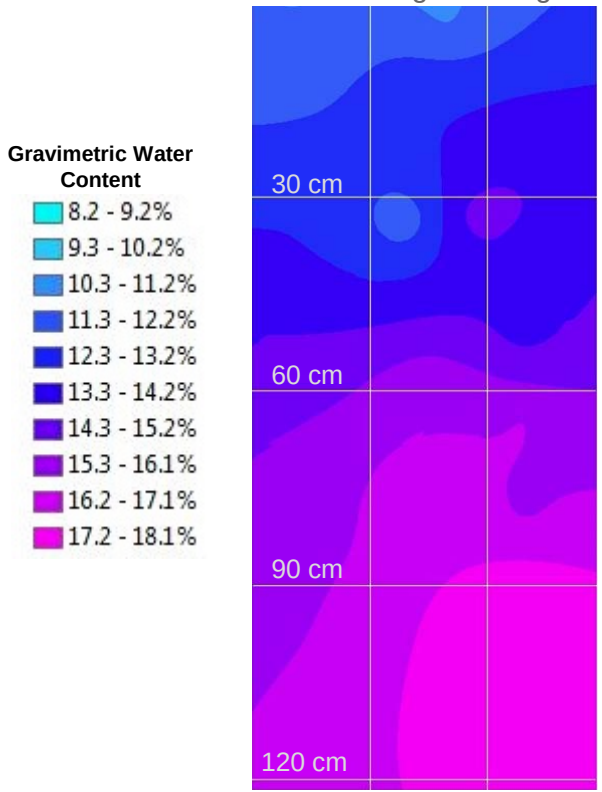


Results - Spring Crop Roots, Moisture, & Nitrate

Pit 2: Naff, SC, GS67: flowering declining

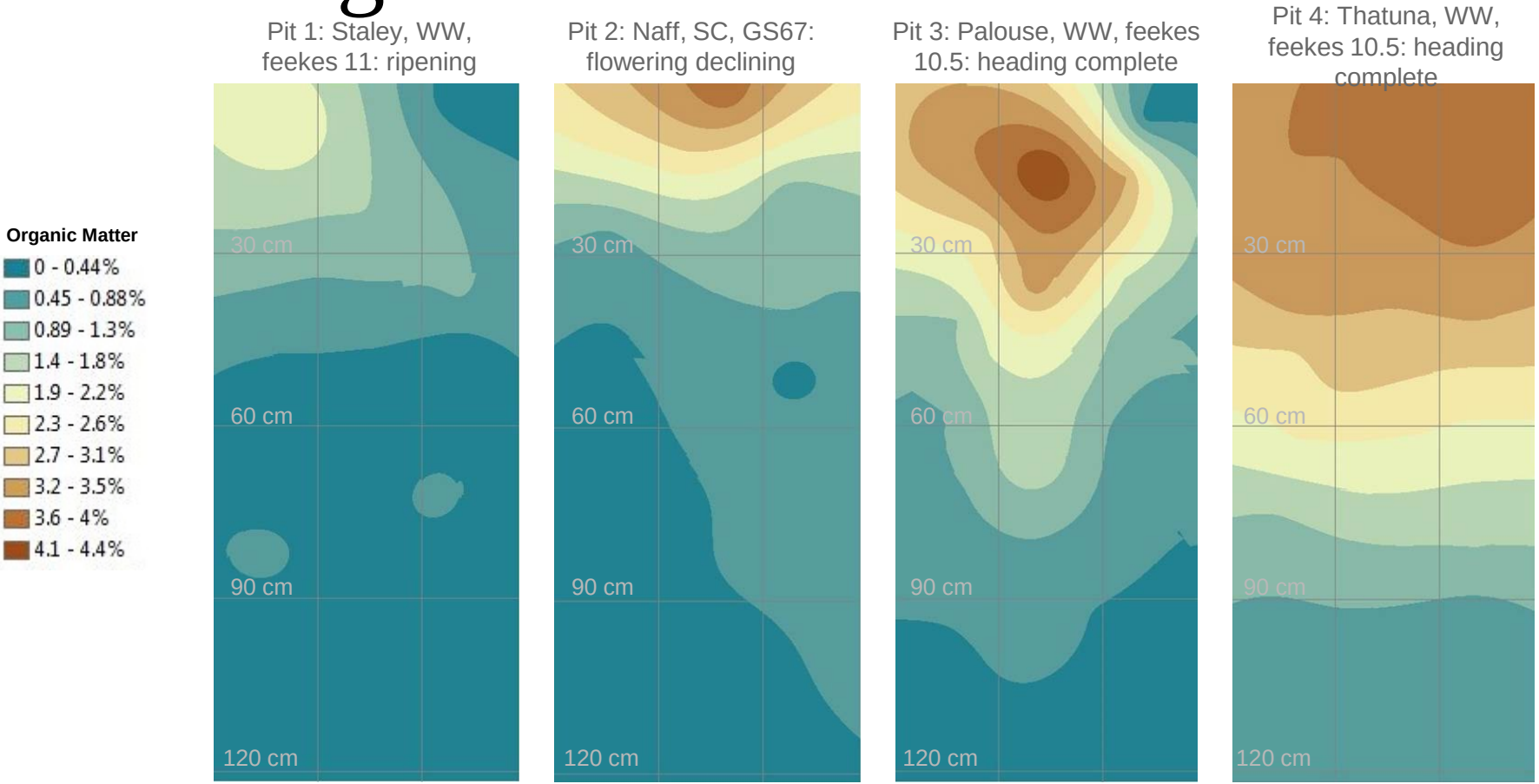


Pit 2: Naff, SC, GS67: flowering declining



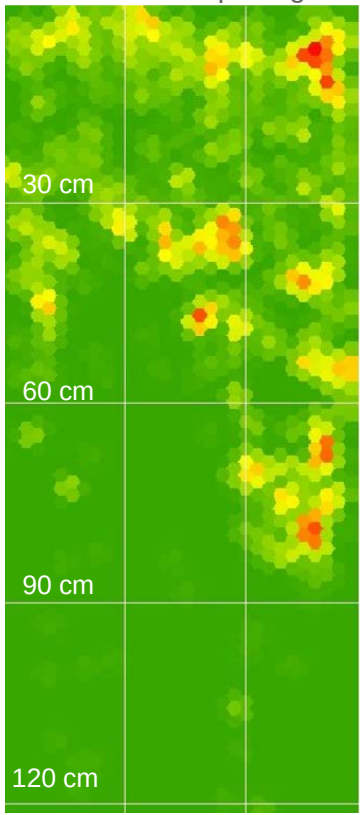
Pit 2: Naff, SC, GS67: flowering declining

Results - Organic Matter



Results - Root Density & Organic Matter

Pit 1: Staley, WW, feekes 11: ripening



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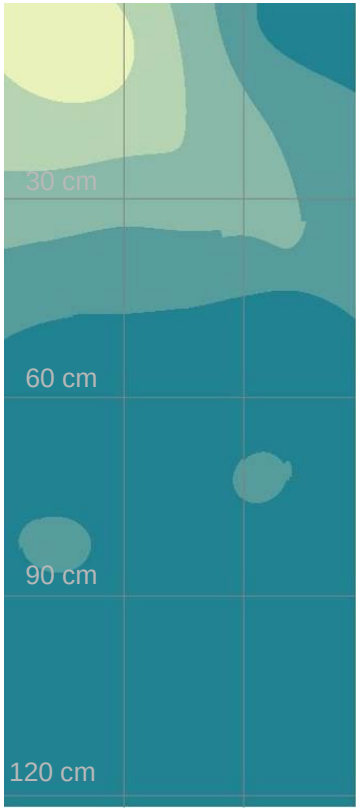


Root Points

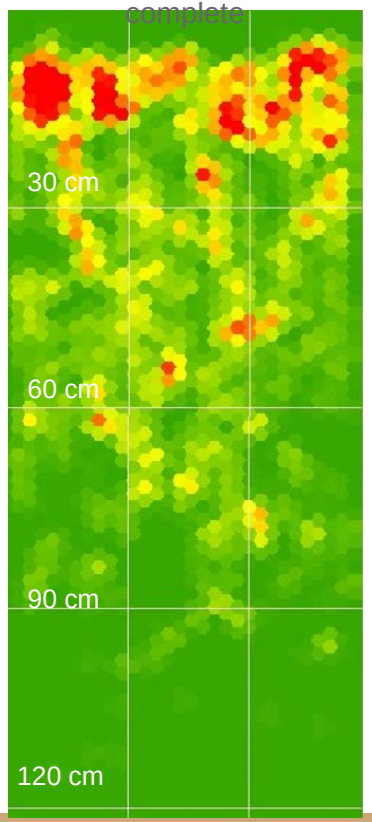
High : 2.5 points

Low : 0 points

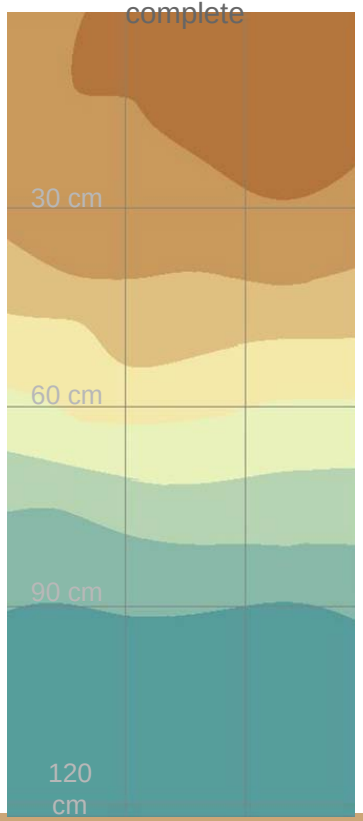
Organic Matter

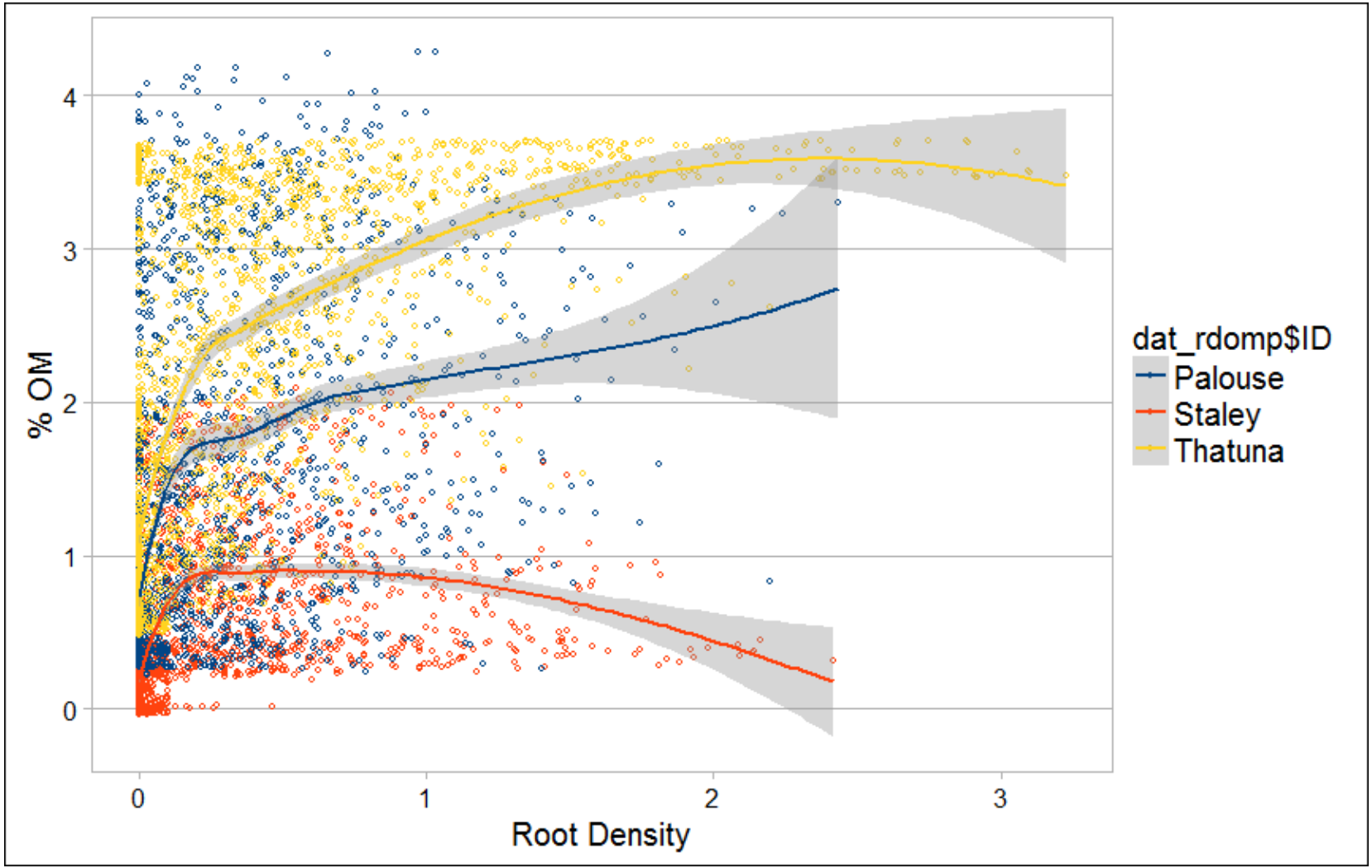
- 0 - 0.44%
- 0.45 - 0.88%
- 0.89 - 1.3%
- 1.4 - 1.8%
- 1.9 - 2.2%
- 2.3 - 2.6%
- 2.7 - 3.1%
- 3.2 - 3.5%
- 3.6 - 4%
- 4.1 - 4.4%

Pit 4: Thatuna, WW, feekes 10.5: heading complete



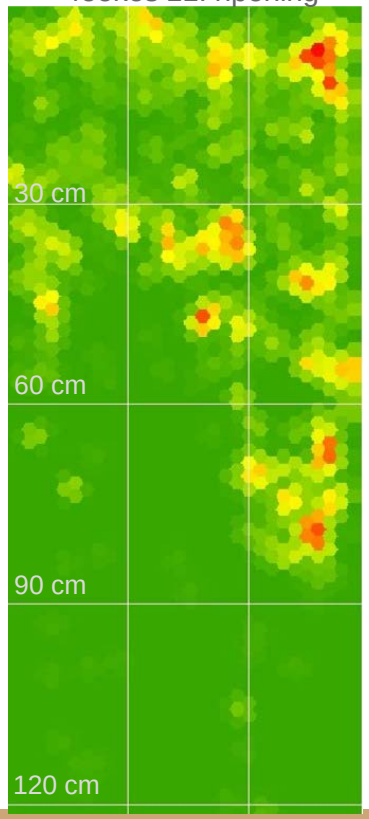
Pit 4: Thatuna, WW, feekes 10.5: heading complete



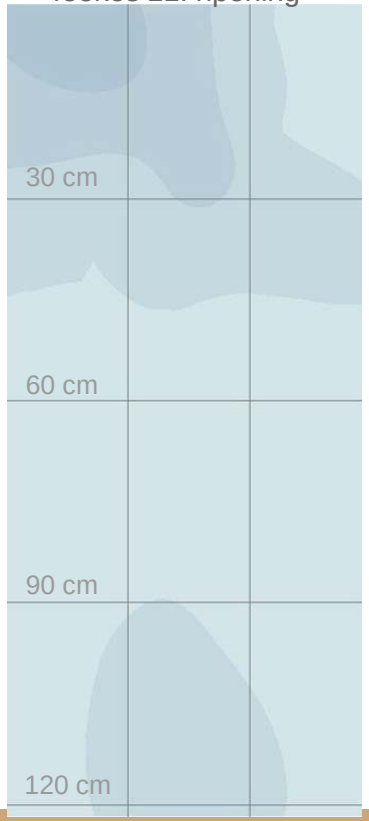

% OM
Root Density
0
1
2
3
4
dat_rdomp$ID
Palouse
Staley
Thatuna

Results - Root Density & Phosphorus

Pit 1: Staley, WW, feekes 11: ripening



Pit 1: Staley, WW, feekes 11: ripening



Root Points

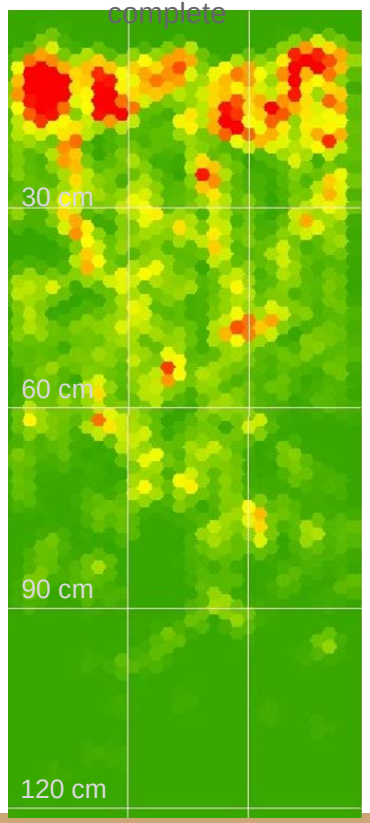
High : 2.5 points

Low : 0 points

Available Phosphorus

- 1.01 - 3.93 ppm
- 3.94 - 6.86 ppm
- 6.87 - 9.79 ppm
- 9.8 - 12.7 ppm
- 12.8 - 15.7 ppm
- 15.8 - 18.6 ppm
- 18.7 - 21.5 ppm
- 21.6 - 24.4 ppm
- 24.5 - 27.4 ppm
- 27.5 - 30.3 ppm
- 30.4 - 33.2 ppm
- 33.3 - 36.2 ppm
- 36.3 - 39.1 ppm
- 39.2 - 42 ppm
- 42.1 - 45 ppm

Pit 4: Thatuna, WW, feekes 10.5: heading complete



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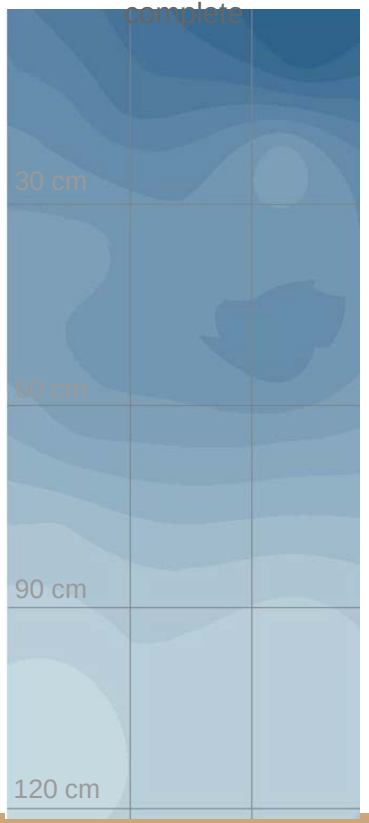
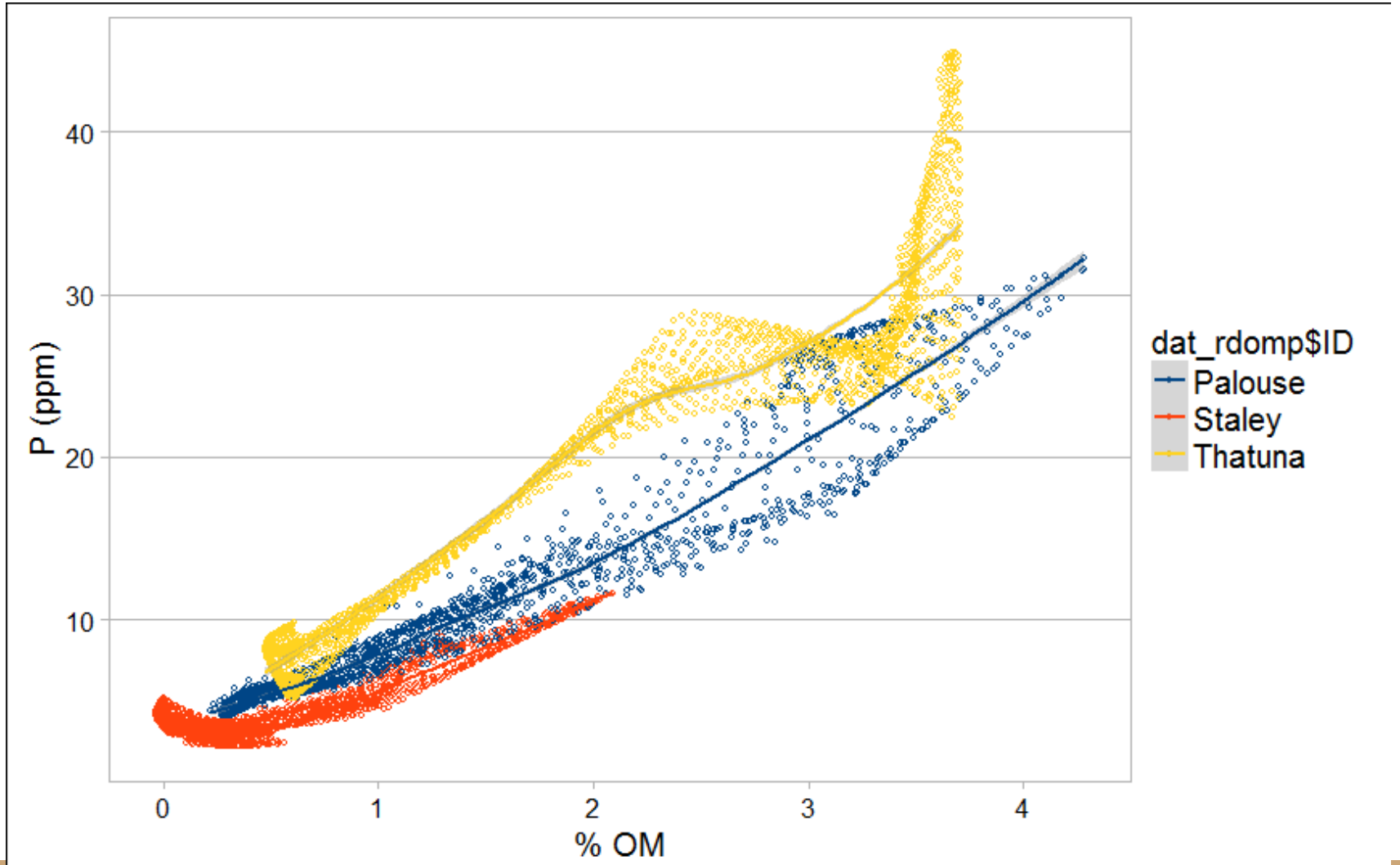
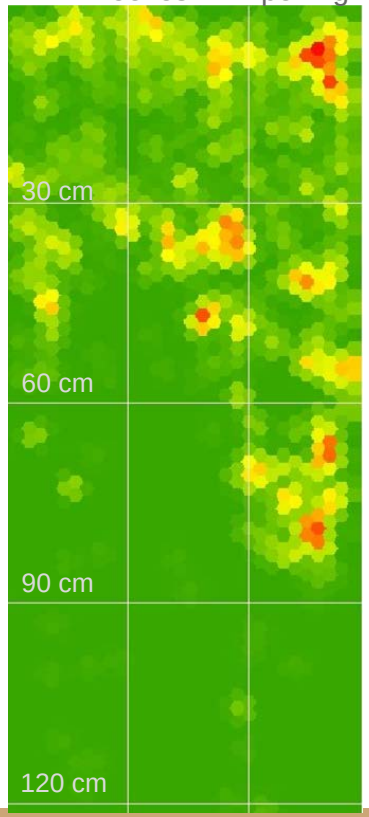



40
30
20
10
P (ppm)
0
1
2
3
4
% OM
dat_rdomp$ID
Palouse
Staley
Thatuna

Results - Root Density, Boron, & Other Nutrients

Pit 1: Staley, WW, feekes 11: ripening



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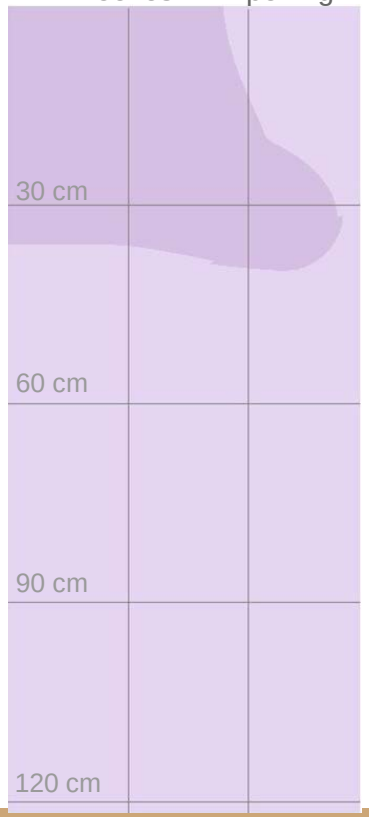


Root Points

High : 2.5 points

Low : 0 points

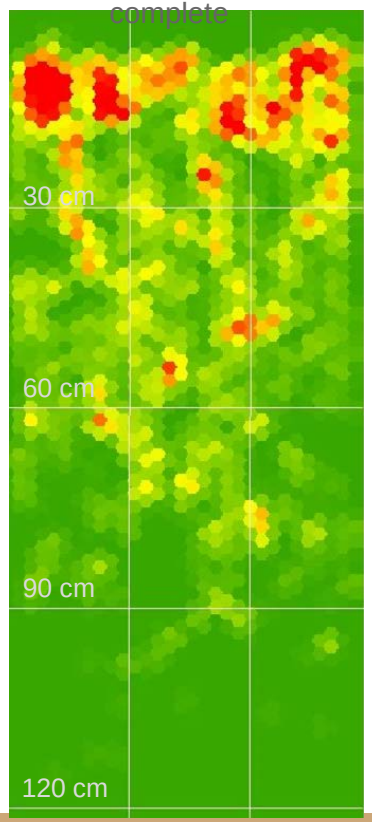
Available Boron

- 0 - 0.11 ppm
- 0.12 - 0.22 ppm
- 0.23 - 0.33 ppm
- 0.34 - 0.44 ppm
- 0.45 - 0.55 ppm
- 0.56 - 0.66 ppm
- 0.67 - 0.77 ppm
- 0.78 - 0.88 ppm
- 0.89 - 0.99 ppm
- 1 - 1.1 ppm

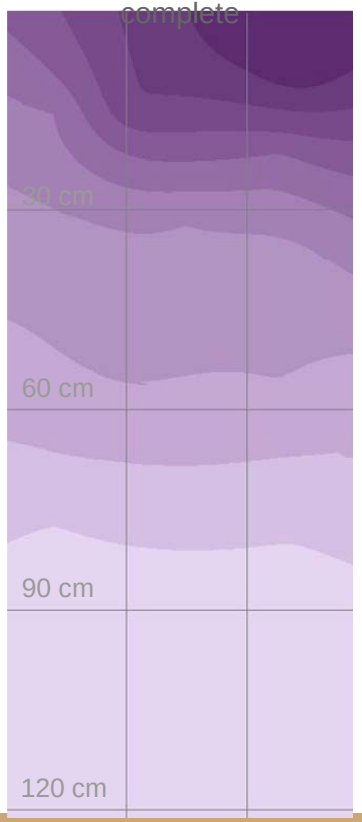
These micronutrients also follow a similar trend:

- Copper
- Iron
- Manganese
- Zinc

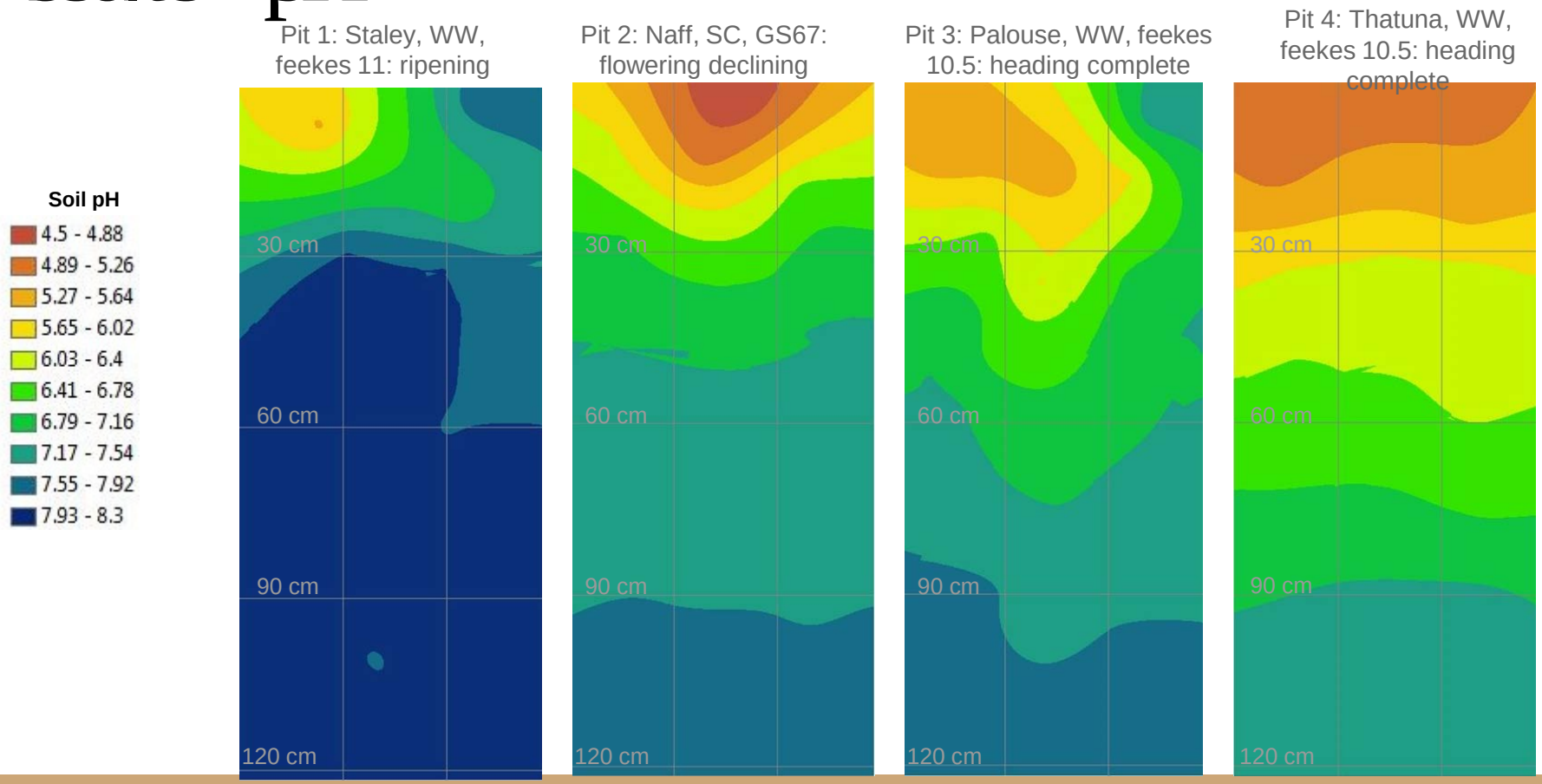
Pit 4: Thatuna, WW, feekes 10.5: heading complete



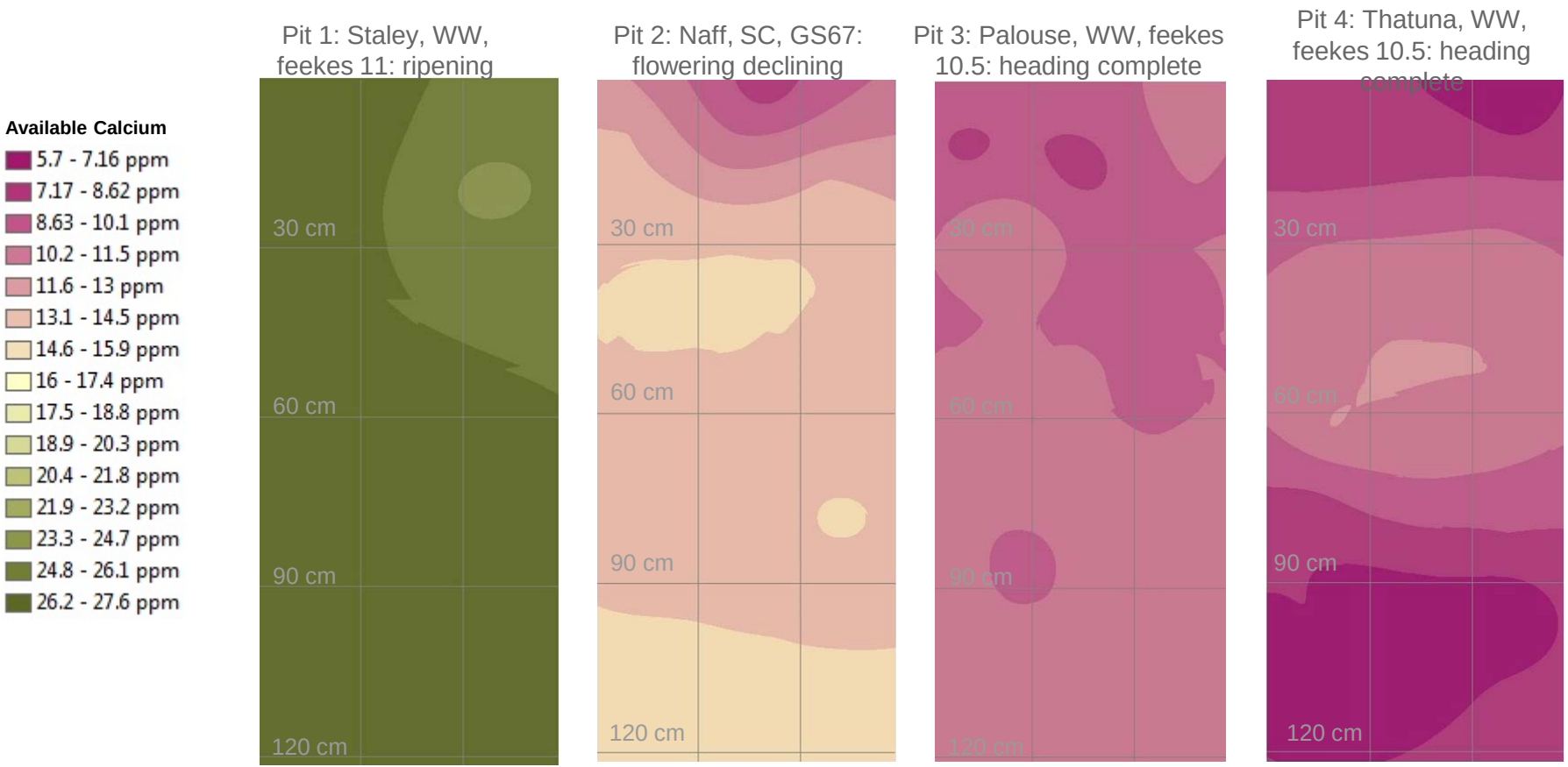
Pit 4: Thatuna, WW, feekes 10.5: heading complete



Results - pH

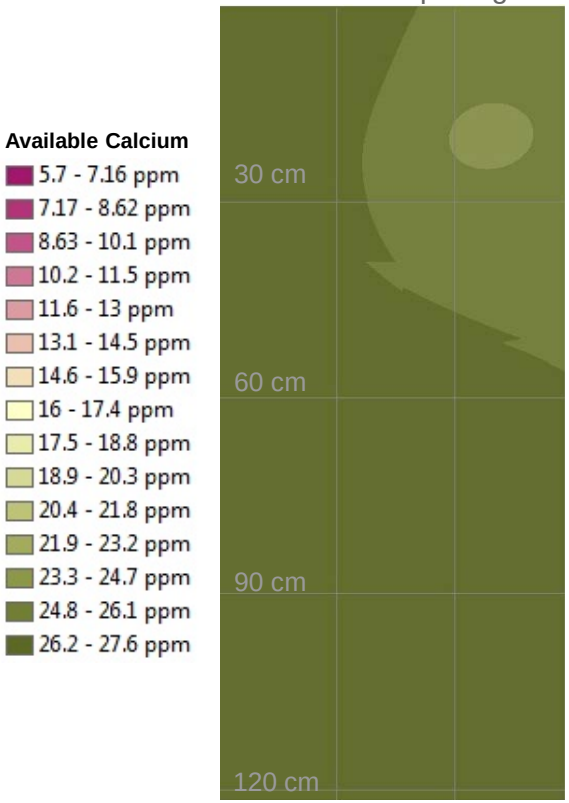

Soil pH
4.5 - 4.88
4.89 - 5.26
5.27 - 5.64
5.65 - 6.02
6.03 - 6.4
6.41 - 6.78
6.79 - 7.16
7.17 - 7.54
7.55 - 7.92
7.93 - 8.3
Pit 1: Staley, WW, feekes 11: ripening
Pit 2: Naff, SC, GS67: flowering declining
Pit 3: Palouse, WW, feekes 10.5: heading complete
Pit 4: Thatuna, WW, feekes 10.5: heading complete
30 cm
60 cm
90 cm
120 cm

Results - Calcium



Results - Ca, pH, and Root Density

Pit 1: Staley, WW, feekes 11: ripening



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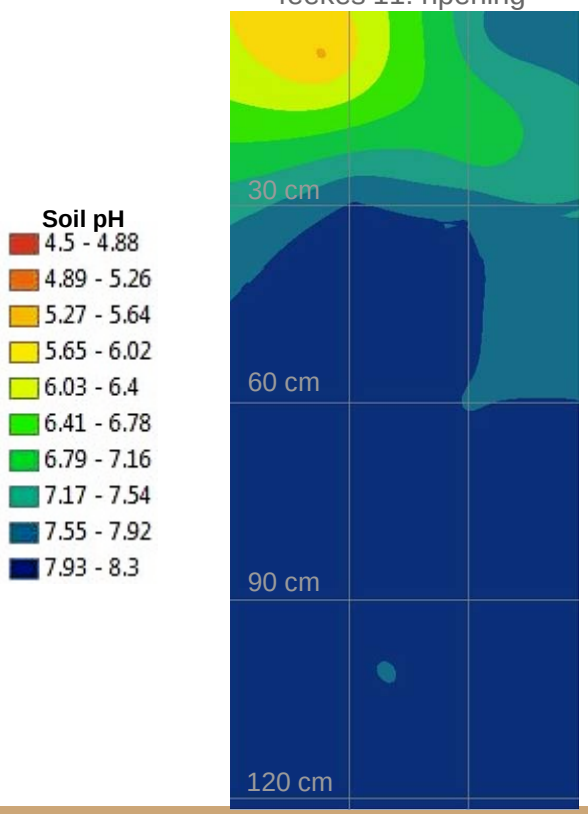

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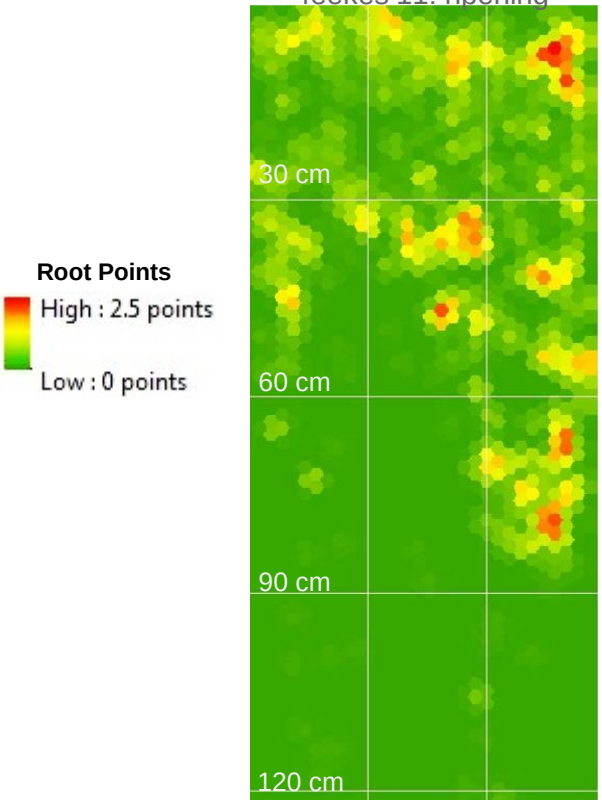

Summary

- Spring and winter crops have different impact on soil nutrient uptake
- Strong correlation between root growth, organic matter, and micronutrients available
- pH and calcium create a physical and chemical restrictive layer that impedes root growth

Conclusion

- Changes in precipitation and climate will call for reliance on subsoil nutrients and water
- Soil testing focused on first few feet of soil
  - Top soil health and quality can differ from that of the subsoil
  - Limited testing on subsoil
- Important to dig deeper to get a better idea of overall health of soil

Big Thanks To...

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Tabitha Brown

Isaac Madsen

REACCH

Dave Huggins

USDA

Questions?