Background

Outside of Integrated Pest Management, little supporting research is available locally to support pea growers in achieving higher crop yields. There is a gap in knowledge on the topic of soil management, crop nutrition, and the impacts of extreme weather on crop yields.

Objective

The Pea Accelerator Challenge set out to systematically survey and collect key field, soil, weather, crop, and crop production data in order to identify trends that may exist in high and/or low yielding peas.

Materials & Methods

15 fields, evenly distributed across the pea growing regions, were selected for inclusion in the project. Five (5) sub-sites were chosen from each field and used as sample locations, based on known historical yield variability, soil type differences, or other factors deemed appropriate, in consultation with the growers.

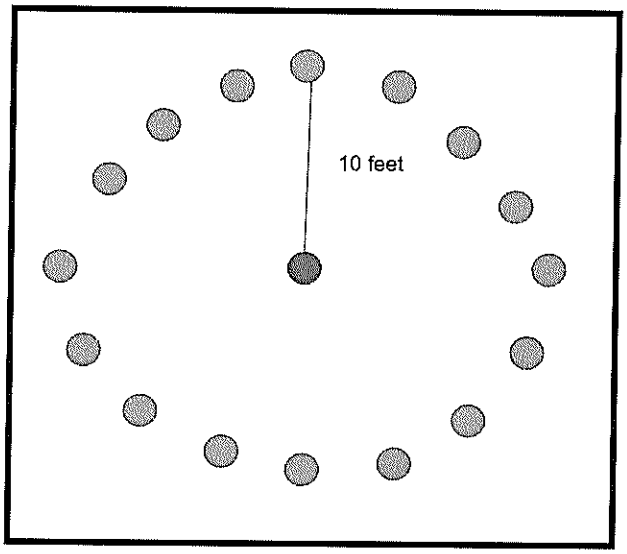
The following information was collected:

- Soil chemistry (i.e. CEC, pH, macro and micro nutrients)
- Soil properties (soil type, water holding capacity, bulk density, total organic carbon)
- All cropping practices employed (i.e. tillage, variety info, fertilizer applications, crop history)
- 3 X plant tissue analysis throughout the season @ 4-node, 10% bloom, and at harvest

Soil Samples Collection

Each sub-site at each location was soil sampled prior to fertilizer application and crop planting.

1. Each sub-site location was GPS located and stored for future reference
2. 10-12 soil cores were taken within a 10' radius of the centre of the subsite at a 6" depth. All cores are mixed in a plastic pail and submissions bags are filled



Tissue Samples Collection

Each sub-site at each location was tissue sampled at 3 key crop stages: 4-node, 10% bloom, immediately prior to harvest

4-node = when 4 nodes have fully expanded leaves
10% bloom = when 10% of plants have at least 1 open flower
Prior to harvest = immediately prior to harvest sample collection

Harvest

Each sub-site at each location was manually harvested in order to collect yield information. 12 rows X 6' (feet) in length was harvested and processed using the standard pea pregrading processes in order to capture yield and tenderometer information.

Results

Of the 15 fields selected, data was fully generated from 12. Of the three sites not completed, one had fertilizer applied prior to soil sampling taking place, and 2 were lost due to commercial harvest occurring prior to manual harvesting of the sample locations.

All data collected was analyzed by Leah Ritcey-Thorpe, Surveillance Coordinator and Data Analyst, OMAFRA. There was large variability in yield within each site as well as large variability in soil variables. The large variability captured was an intentional aspect of the experimental design; however, the extreme variability has led to difficulties extracting trends and relationships between yield and the variables measured.

To account for variability across one site, we recommend that the future experimental design include a larger number of subsites on each farm. The subsites within one site should also be randomly chosen to capture a realistic picture of the variability. e.g.: ~ 20 subsites within one site, fewer sites overall.

MEANS AND VARIANCE IN YIELD

Table 1. The average yield, standard deviation, and coefficient of variation (CV) for each grower. The highest variability of yield occurred in site 9 and the lowest variability occurred in site 5.

Grower ID	Number of subsites	Average Yield (tons/acres)	Standard Deviation	Coefficient of Variation (CV) (%) Calculated as the standard deviation / mean x 100. The coefficient of variation shows the degree of variability in yield between the 5 subsites for each grower.
1	5	3.204	0.747	23.3%
2	5	3.196	0.579	18.1%
3	5	2.546	0.302	11.9%
4	5	2.530	0.866	34.2%
5	5	2.224	0.231	10.4%
6	5	2.212	0.725	32.8%
7	5	2.202	0.542	24.6%
8	5	2.170	0.512	23.6%
9	5	2.126	0.833	39.2%
10	5	2.058	0.426	20.7%
11	5	1.964	0.348	17.7%
12	4	1.860	0.627	33.7%

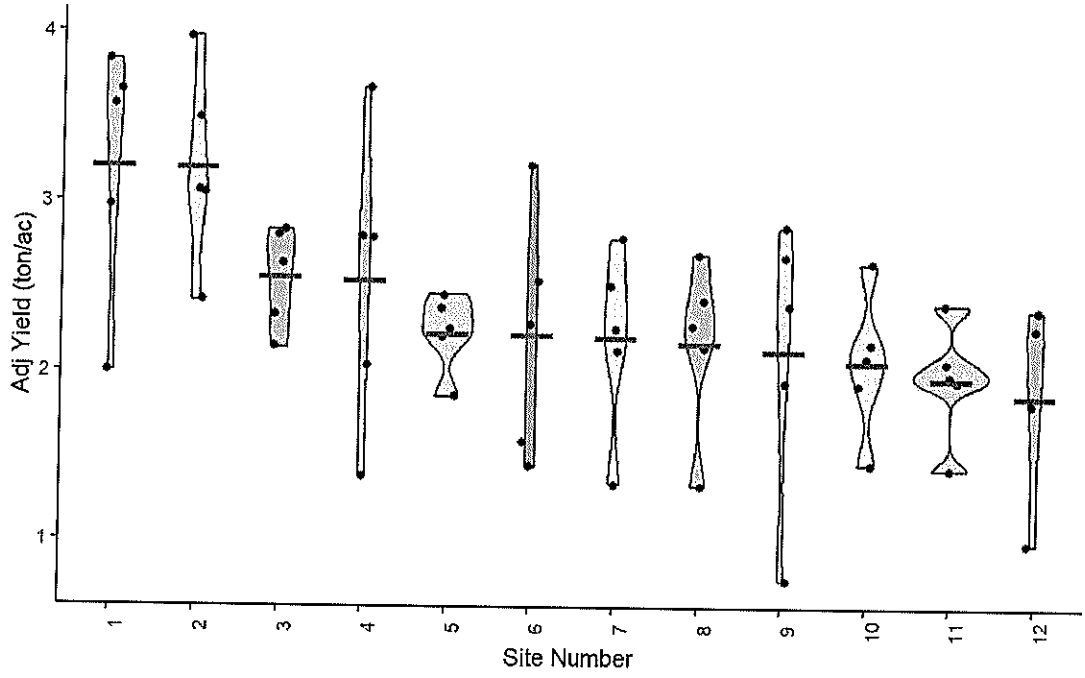


Figure 1. "Violin plot" depicting the distribution of yield on each site. Points represent the yield taken from each site and the red cross bar represents the average yield for

that site. Interpretation: long, thin = more variability in yield; short, wide = less variability in yield.

BOXPLOTS – SOIL AND TISSUE VARIABLES

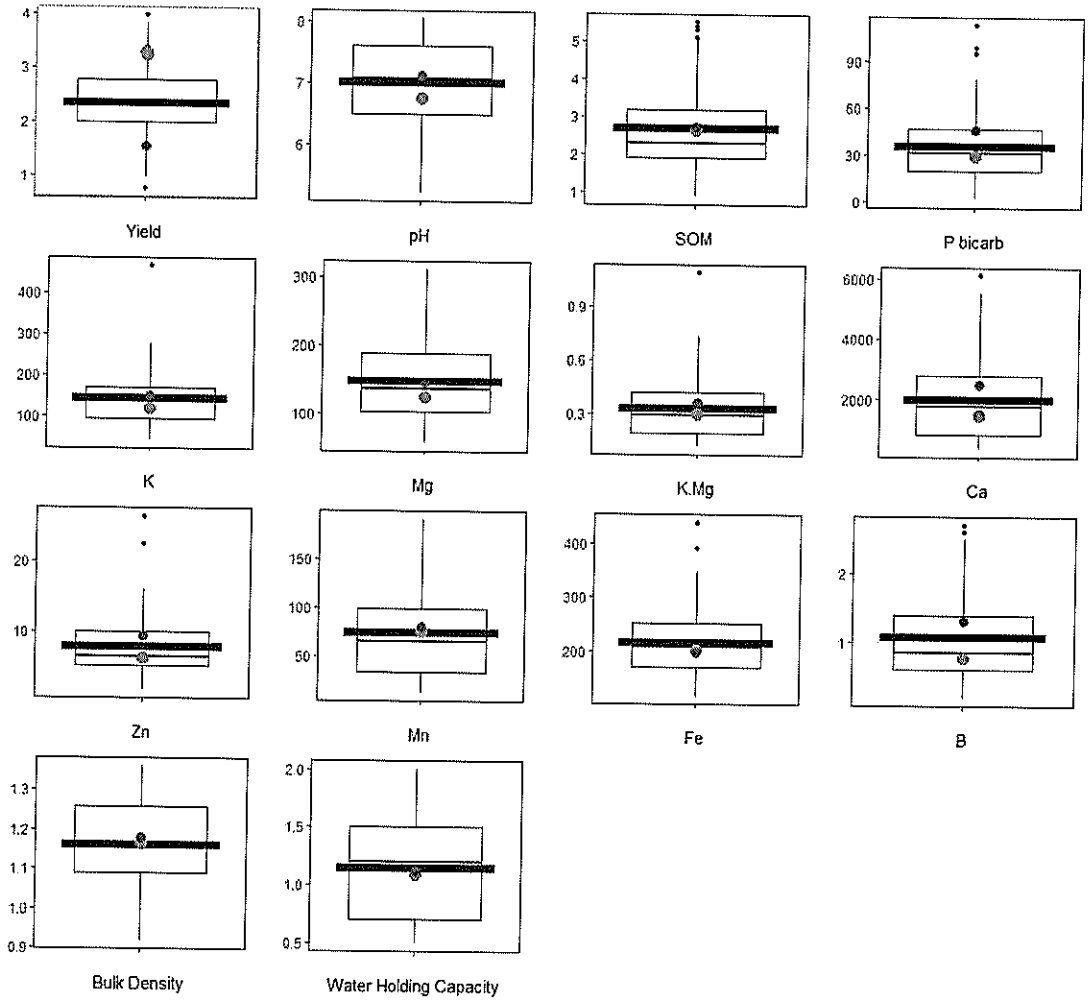


Figure 2. Boxplots depicting soil variables across all sites, where the total number of data points = 59. No significant differences depicted between the top 25% highest yielding sites and the rest of the data for any of the soil variables listed above.

-The inside of box represents 50% of the data
-Red cross bar = average of all data points for that soil variable
-Black dots = outliers
-Green dot = average of the top 25% highest yielding sites
-Red dot = average of the bottom 25% lowest yielding sites
-Green outline = The difference between the top 25% highest yielding sites and the **rest** of the data for that variable was statistically different with $p < 0.05$ as determined by either a Wilcoxon rank sum or Welch two-sample t-test.

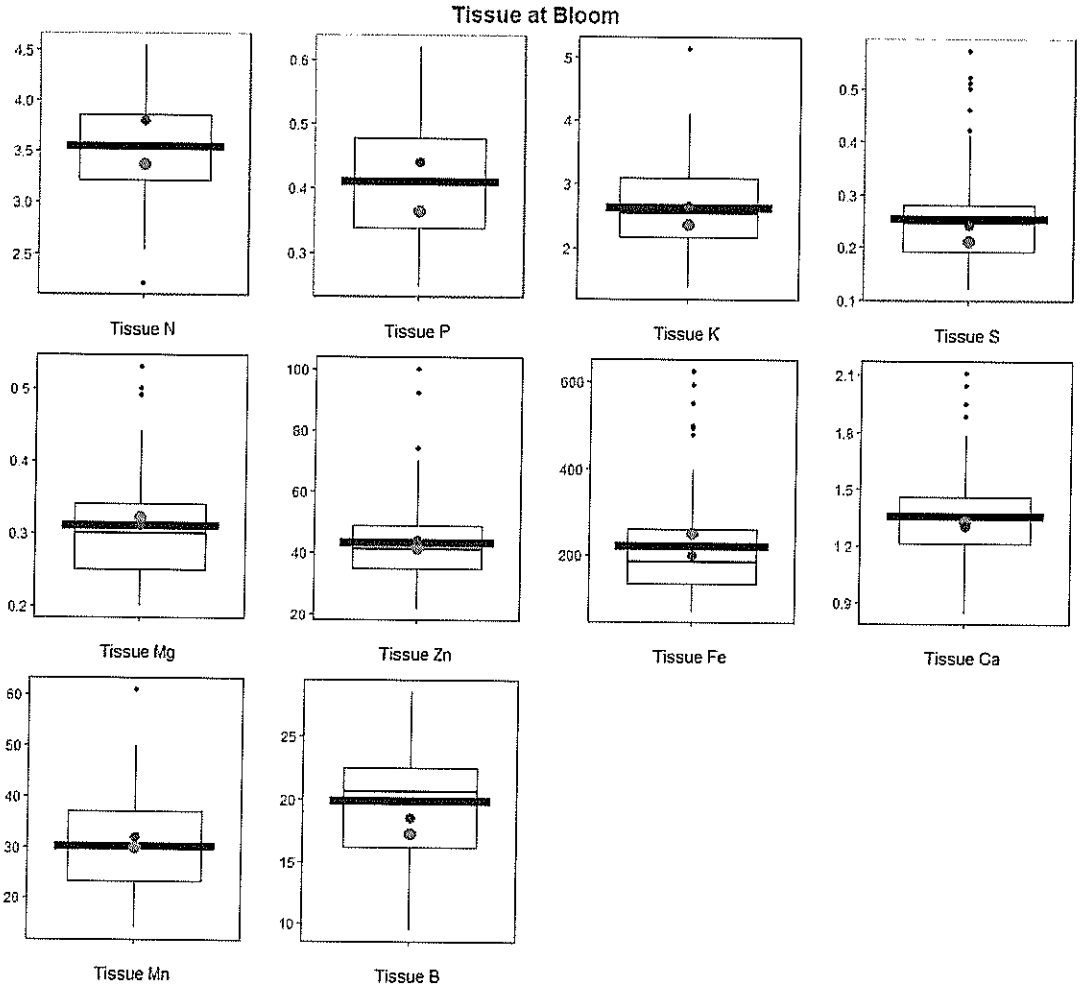


Figure 3. Boxplots depicting tissue variables at bloom across all sites, where the total number of data points = 59. Significant differences depicted between the top 25% highest yielding sites and the rest of the data for tissue S, tissue N, and tissue P.

-The inside of box represents 50% of the data
-Red cross bar = average of all data points for that soil variable
-Black dots = outliers
-Green dot = average of the top 25% highest yielding sites
-Red dot = average of the bottom 25% lowest yielding sites
-Green outline = The difference between the top 25% highest yielding sites and the **rest** of the data for that variable was statistically different with $p < 0.05$ as determined by either a Wilcoxon rank sum or Welch two-sample t-test.

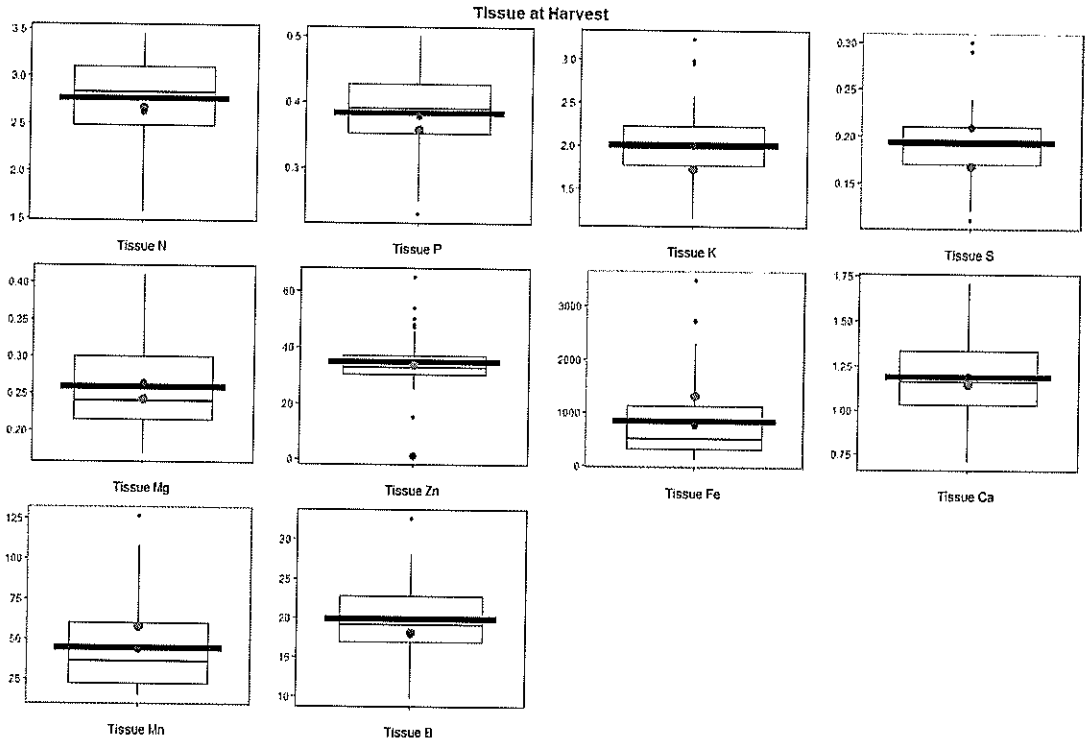
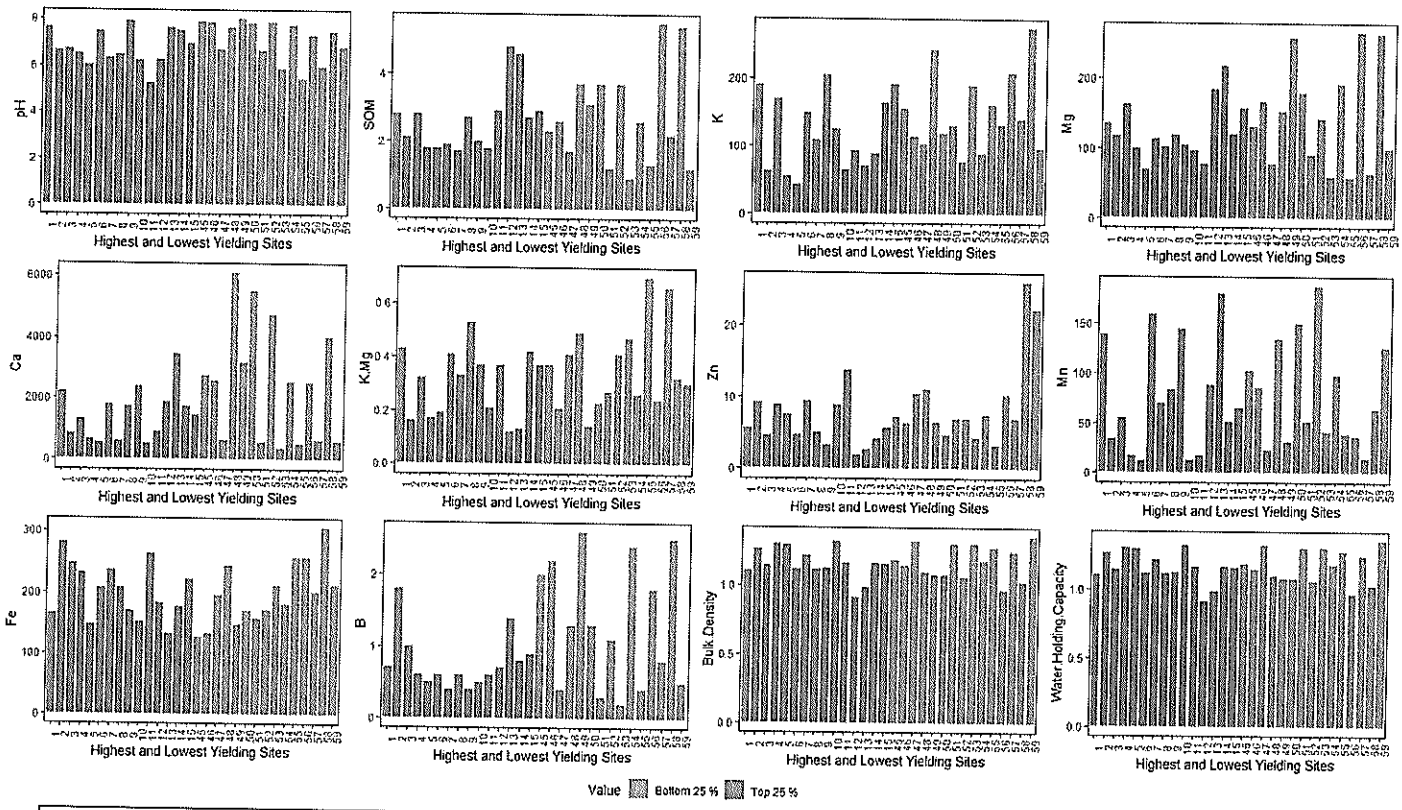


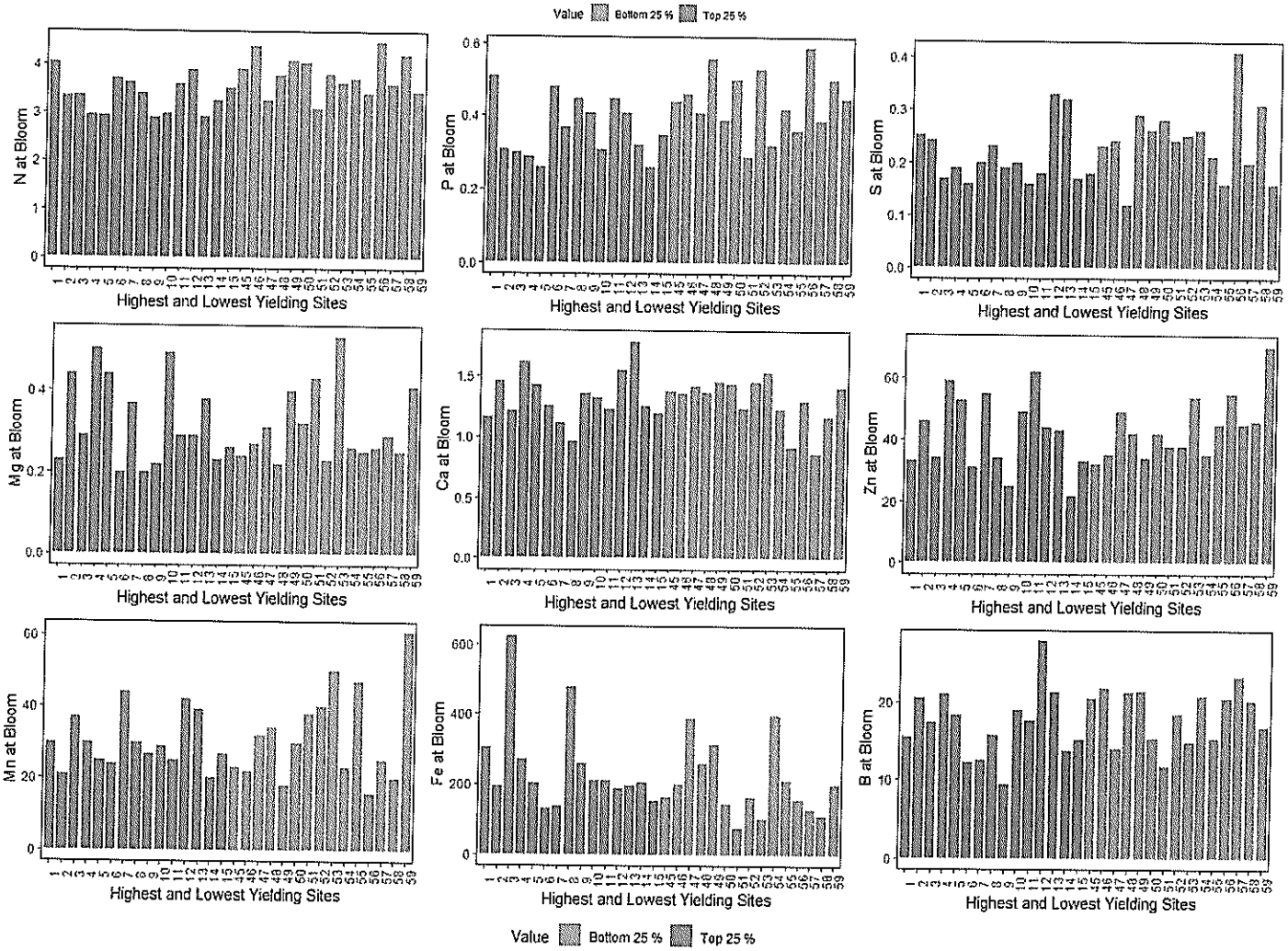
Figure 4. Boxplots depicting tissue variables at harvest across all sites, where the total number of data points = 43. *Site 1, 4, and 8 excluded from the analysis due to inconsistency in harvest methods. Significant differences depicted between the top 25% highest yielding sites and the rest of the data for tissue S, tissue Fe, and tissue Mn.

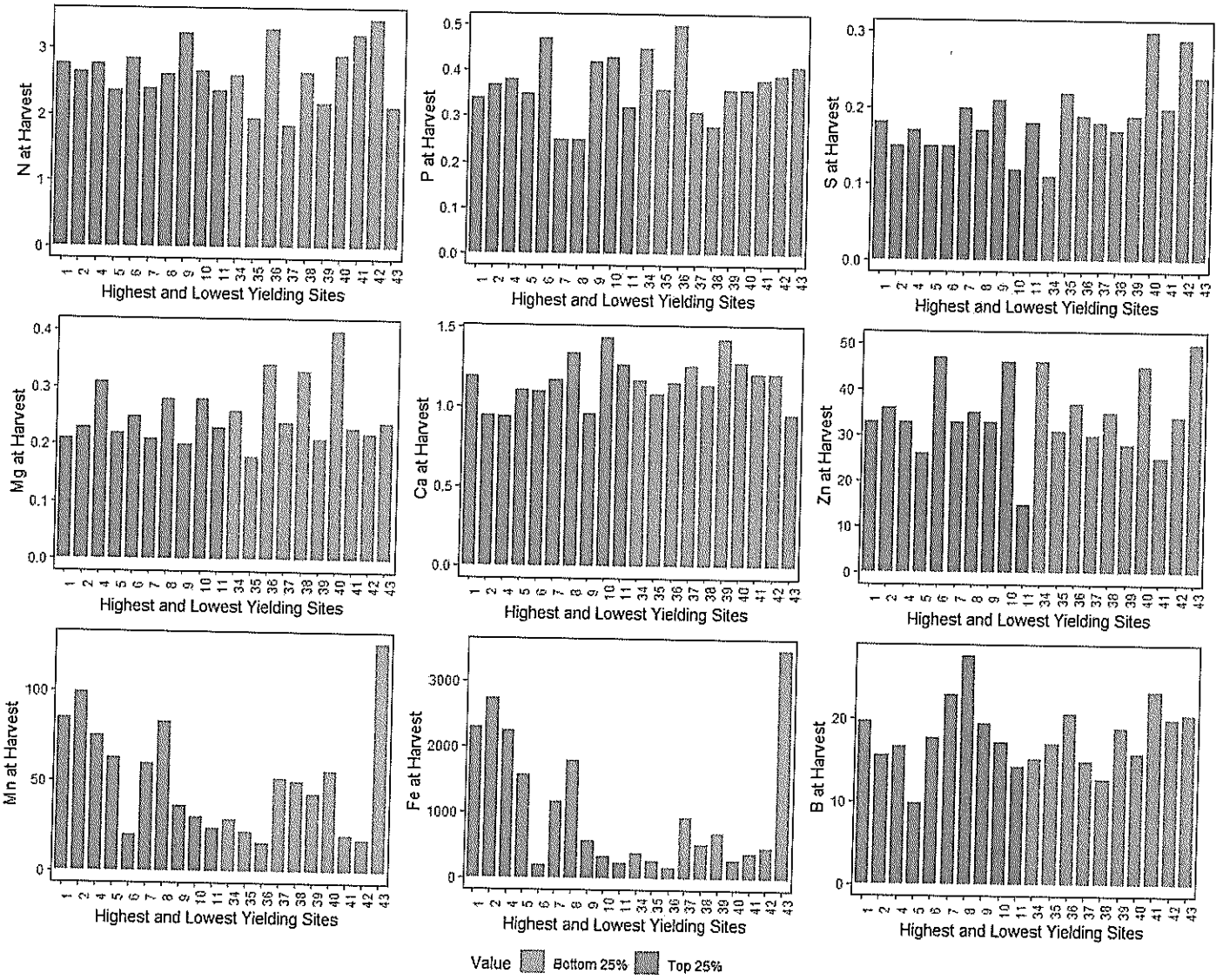
-The inside of box represents 50% of the data
-Red cross bar = average of all data points for that soil variable
-Black dots = outliers
-Green dot = average of the top 25% highest yielding sites
-Red dot = average of the bottom 25% lowest yielding sites
-Green outline = The difference between the top 25% highest yielding sites and the **rest** of the data for that variable was statistically different with $p < 0.05$ as determined by either a Wilcoxon rank sum or Welch two-sample t-test.

BAR PLOTS

The following bar plots represent the 25% highest yielding and 25% lowest yielding subsites for each measured variable. The purpose of the bar graphs are to visually showcase which variables have high variability within the highest and lowest yielding subsites in terms.


pH
SOM
K
Mg
Ca
K.Mg
Zn
Mn
Fe
B
Bulk.Density
Water.Holding.Capacity
Highest and Lowest Yielding Sites
Value Bottom 25 % Top 25 %


N at Bloom
P at Bloom
S at Bloom
Mg at Bloom
Ca at Bloom
Zn at Bloom
Mn at Bloom
Fe at Bloom
B at Bloom
Highest and Lowest Yielding Sites
Value Bottom 25 % Top 25 %


N at Harvest
P at Harvest
S at Harvest
Mg at Harvest
Ca at Harvest
Zn at Harvest
Mn at Harvest
Fe at Harvest
B at Harvest
Highest and Lowest Yielding Sites
Value
Bottom 25%
Top 25%