Nutrient Concentrations and Balance in Corn Tissue Under Field Conditions

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(emeritus)

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Rationale

- Modern high yielding corn hybrids need more nutrients

  corn yields have increased 100 % in 20 years

- Nutrient needs change with growth stage

  can nutrient supply keep up with crop needs

- Location / area specific

  soil organic matter *and* ***mineral differences***

- Hybrid differences ?
- Are nutrient adequacy guidelines appropriate ?

Review

Year 1 (2012)

- Demonstrated that ear-leaf concentrations were the most likely to indicate deficiency
- Most ear-leaf nutrient concentrations ***appeared to be dependent*** on leaf N status

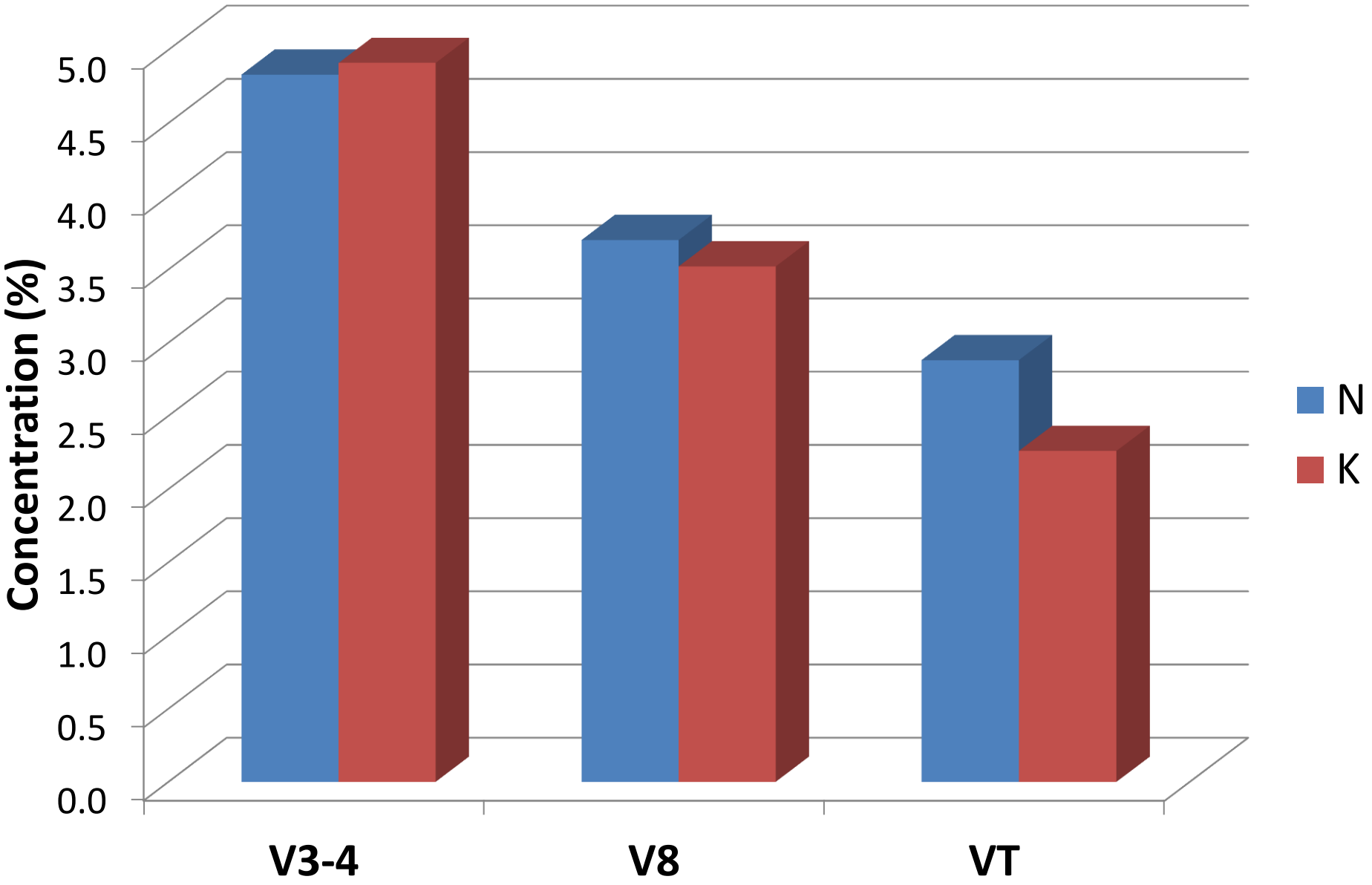
Year 2 (2013)

- Confirmed that most ear-leaf nutrient concentrations ***were dependent*** on leaf N status , but with some location effects

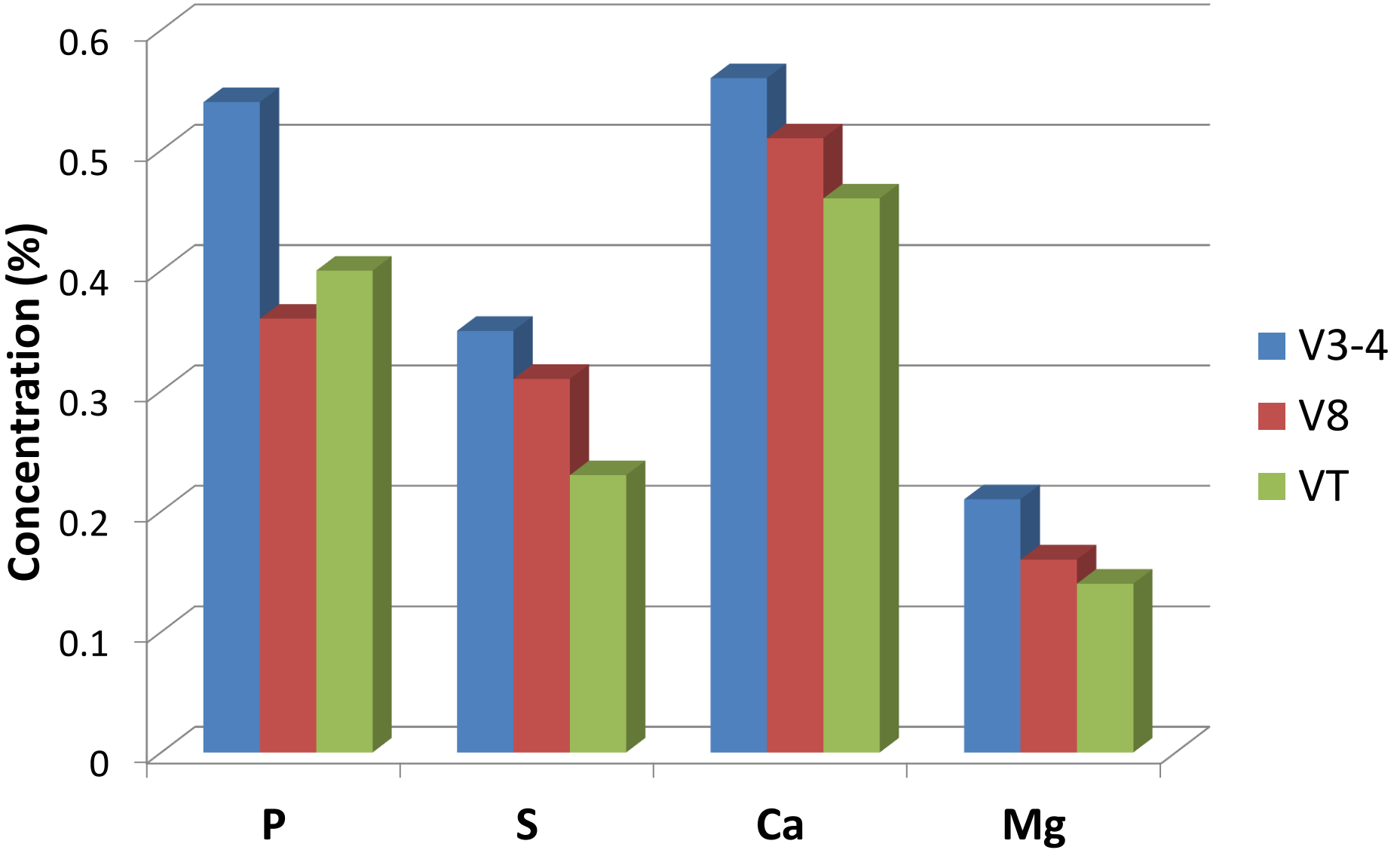
Year 3 (2014)

- - New Observations - -

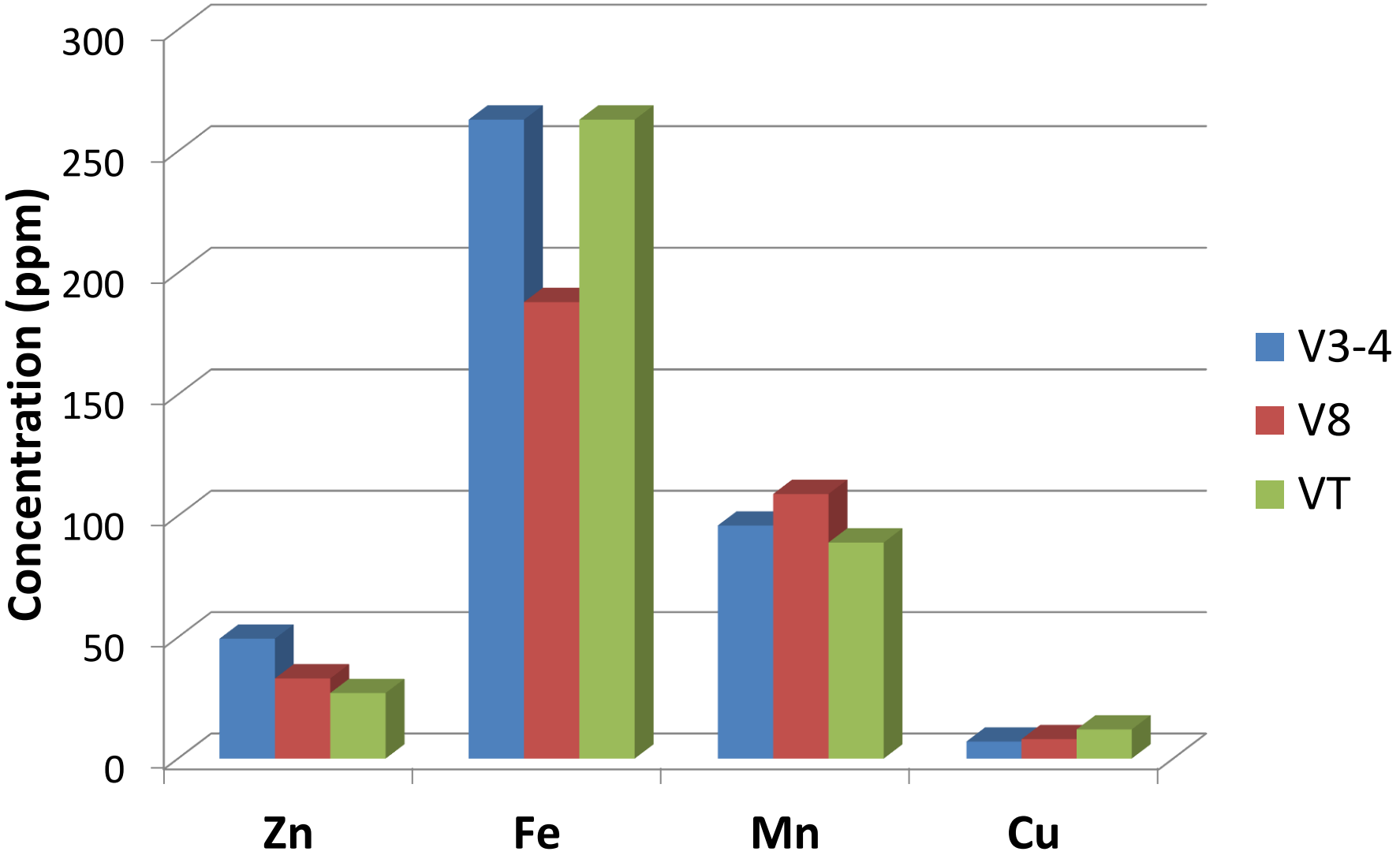
Effect of Growth Stage *Shelton - 2012*



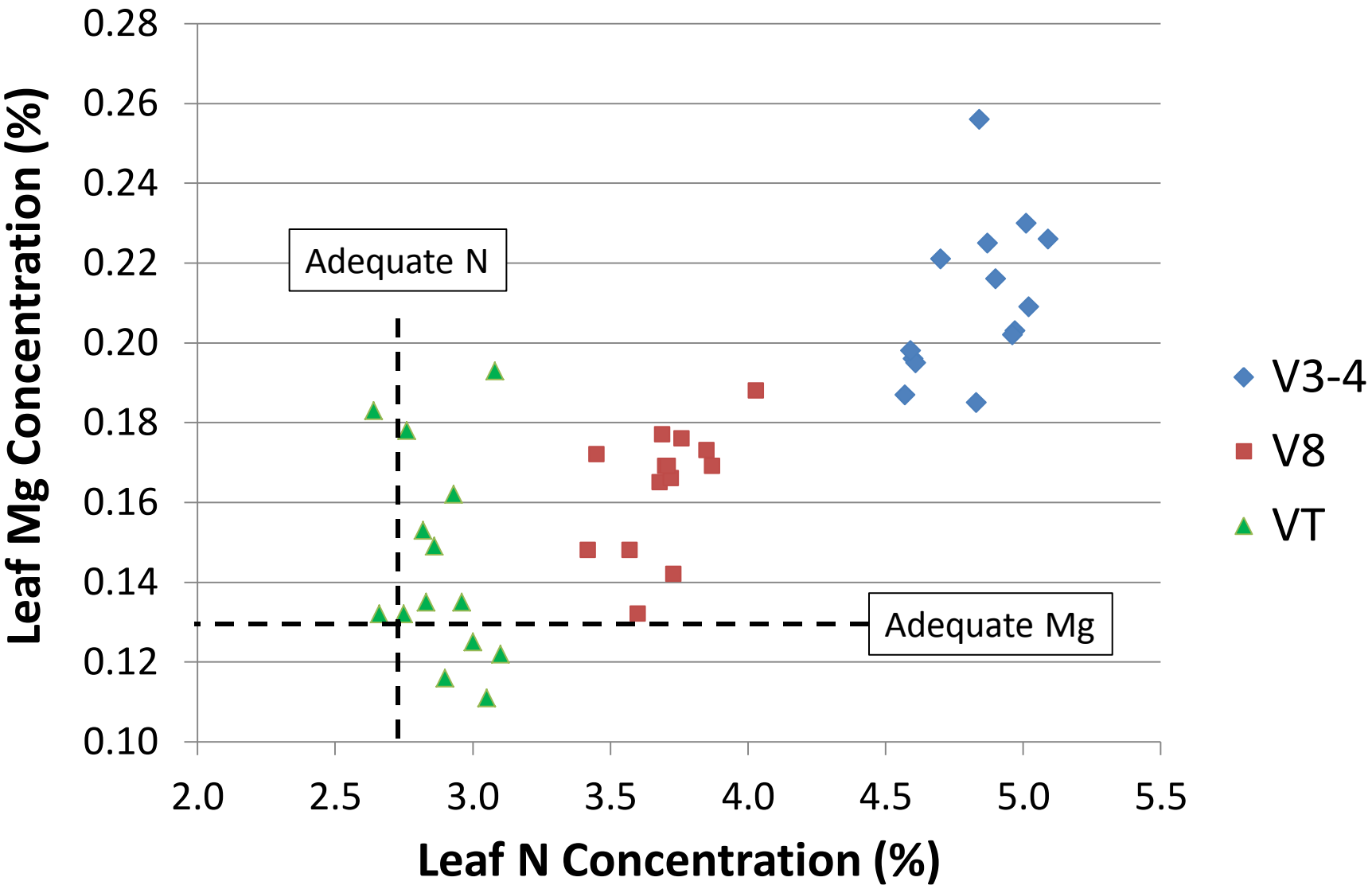
Effect of Growth Stage *Shelton - 2012*



Effect of Growth Stage *Shelton - 2012*

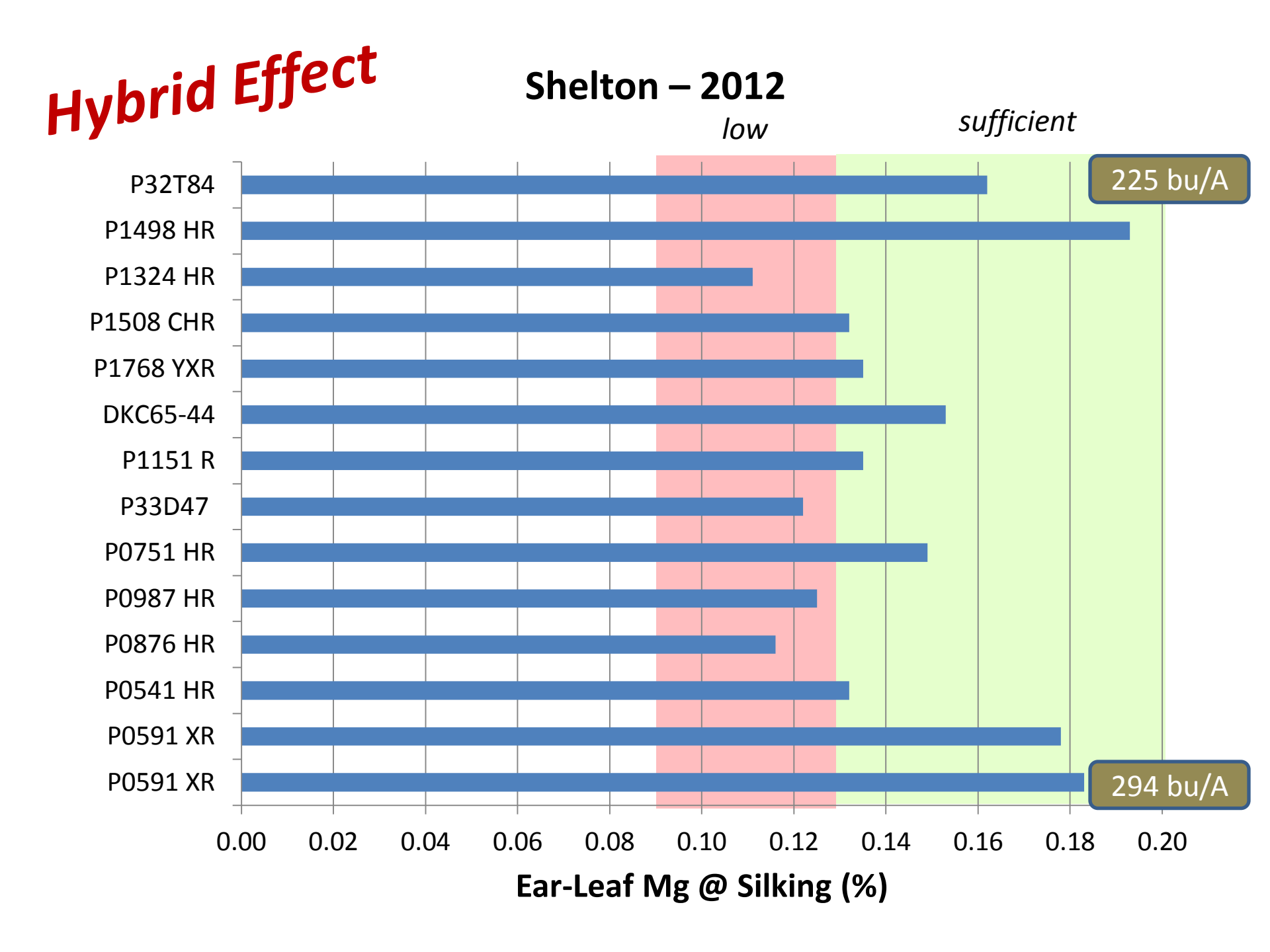


Shelton - 2012 VT

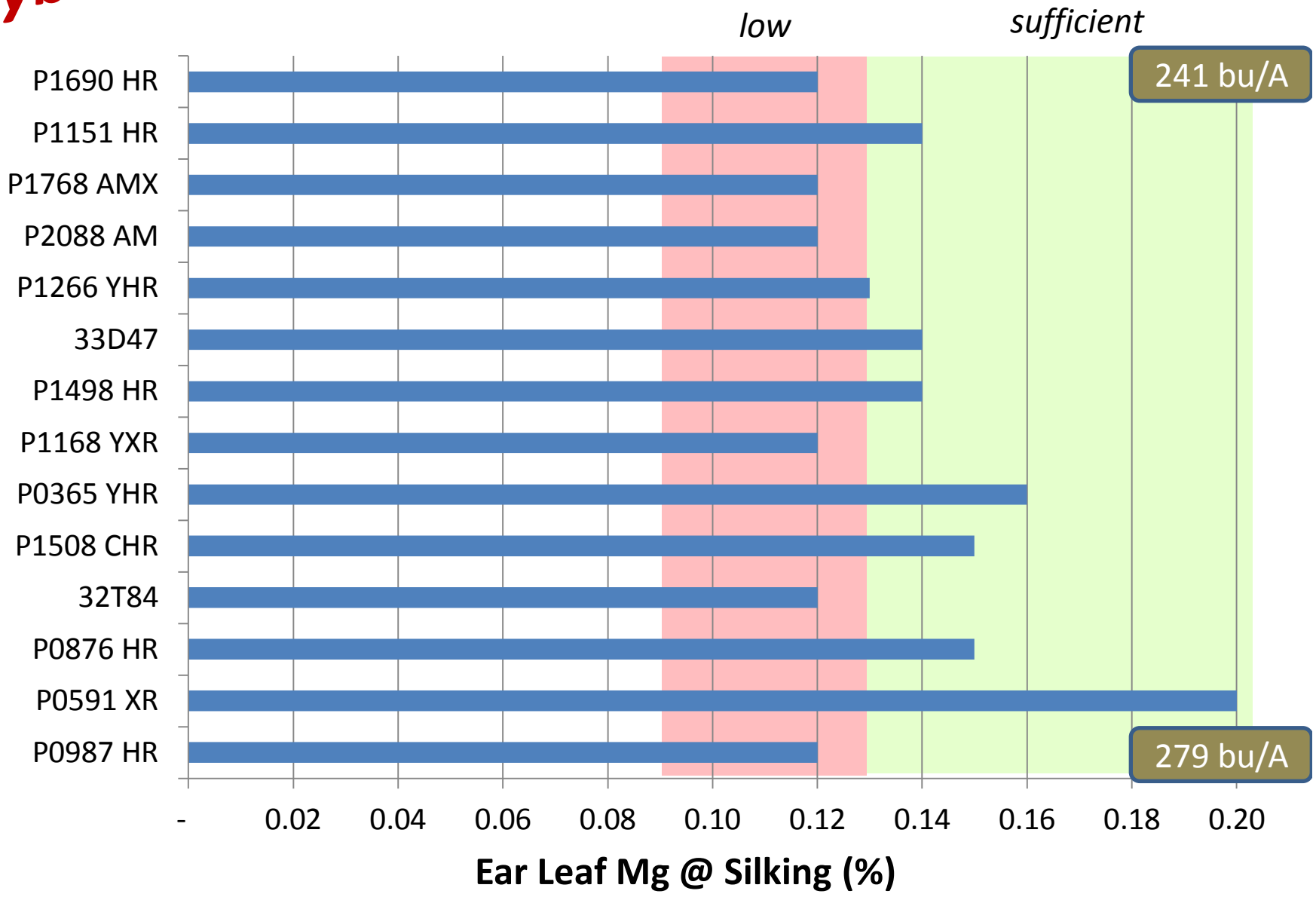


Ear-Leaf Sampling VT

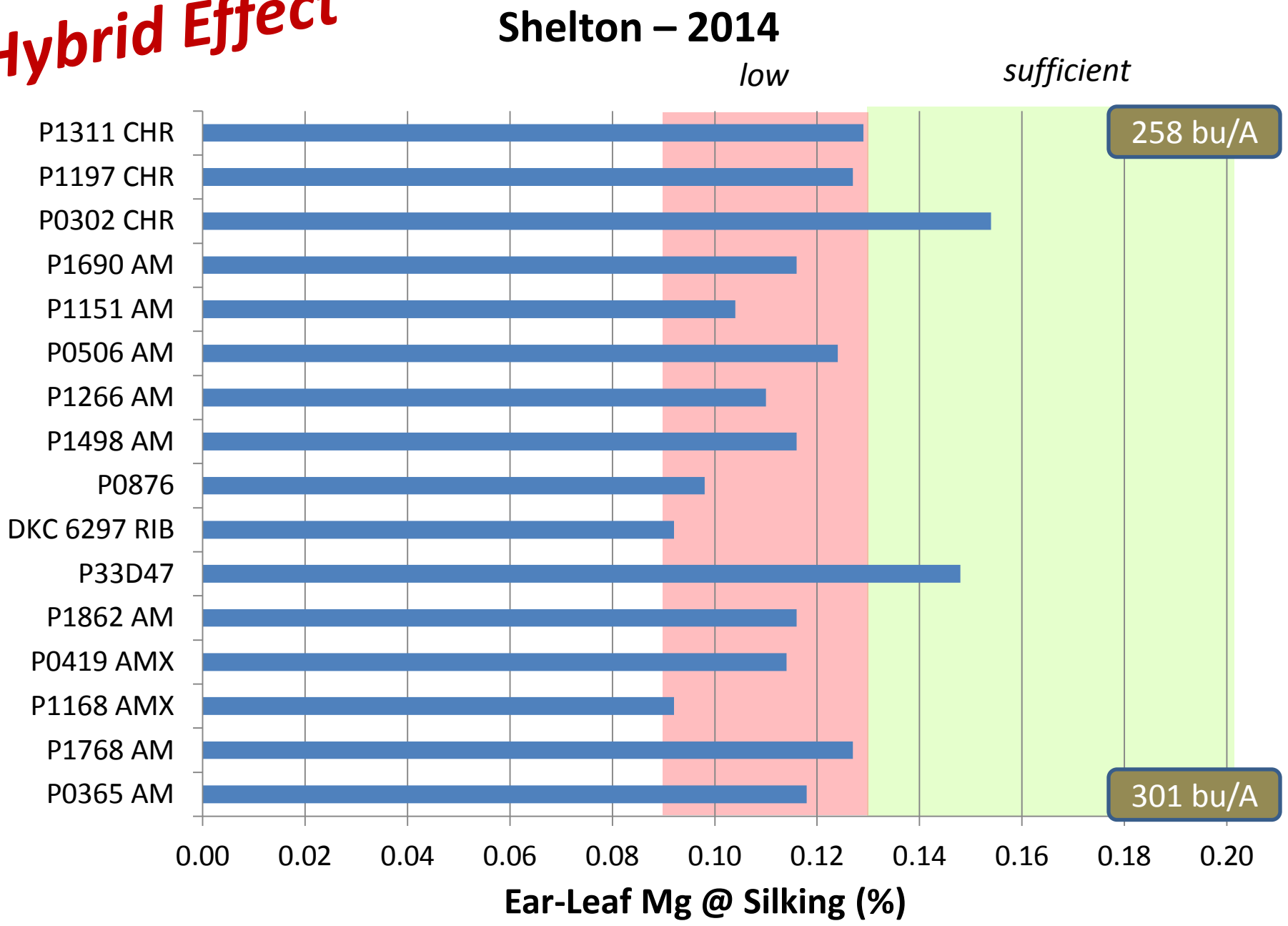
Hybrid Effect

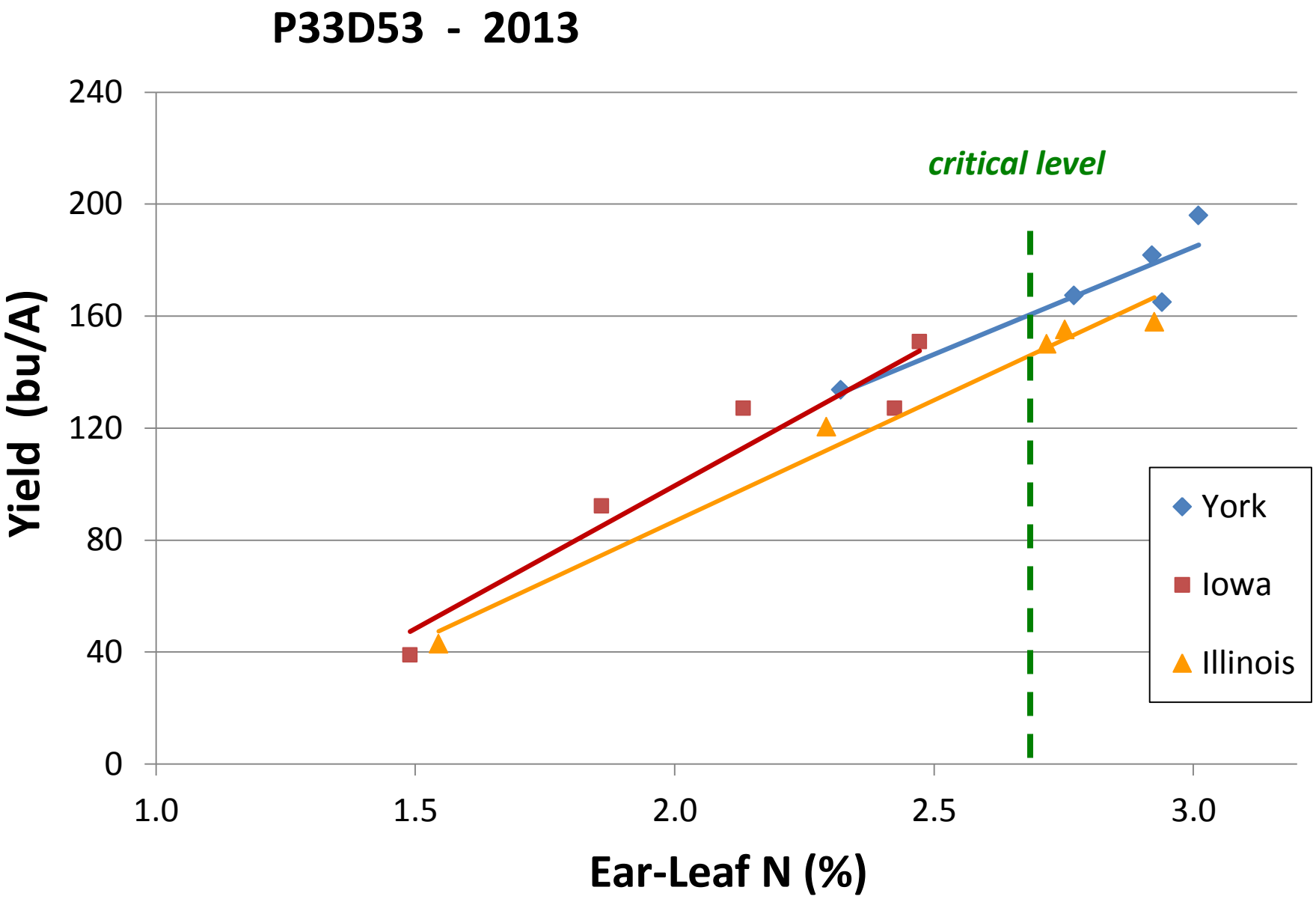


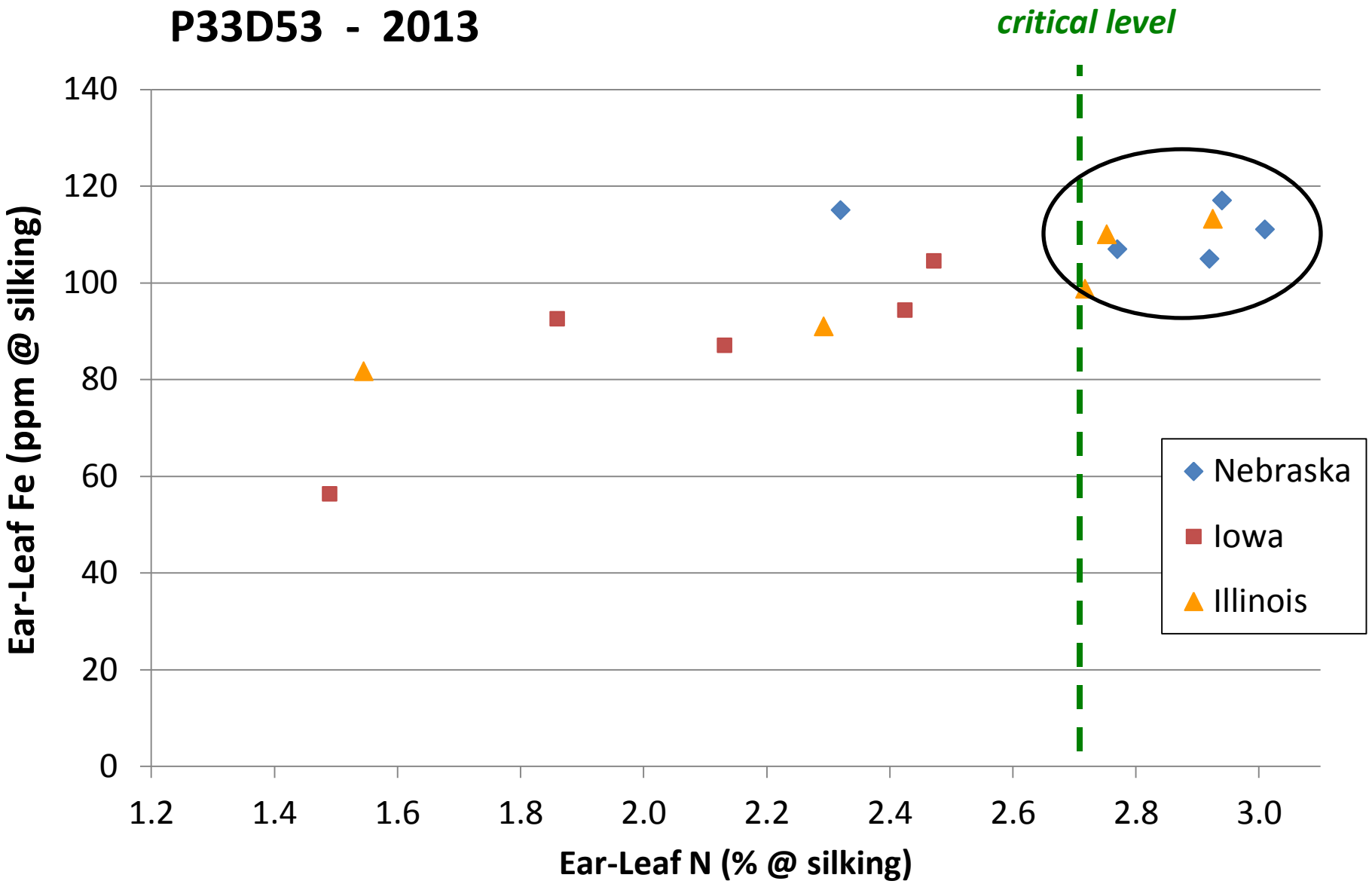
Hybrid Effect

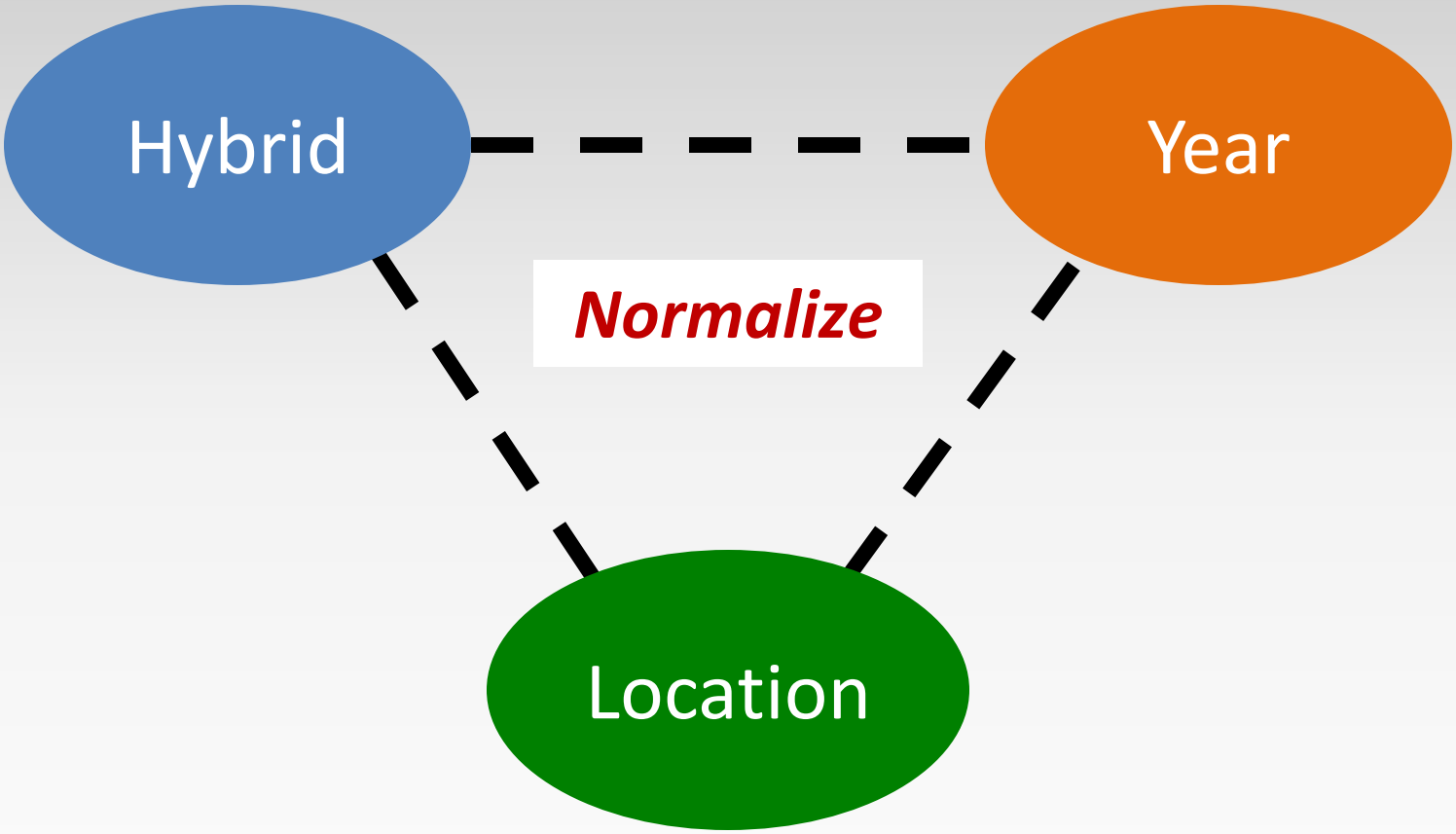


Hybrid Effect



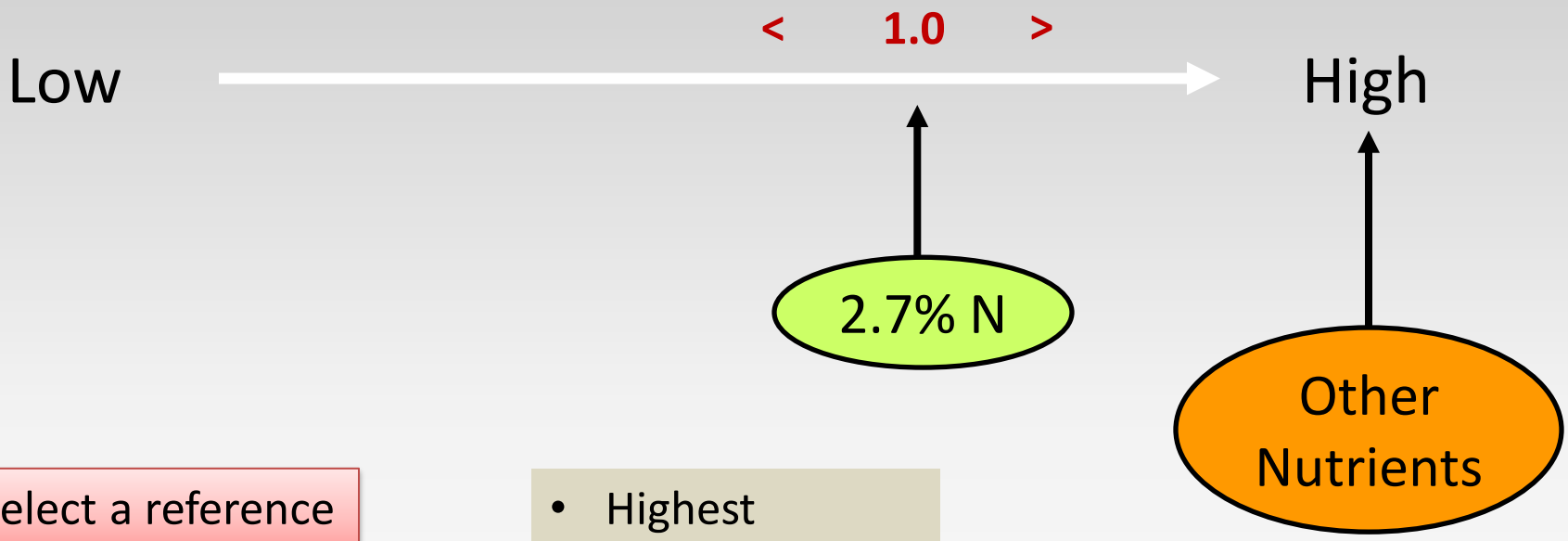

P33D53 - 2013
critical level
Yield (bu/A)
240
200
160
120
80
40
0
1.0
1.5
2.0
2.5
3.0
Ear-Leaf N (%)
York
Iowa
Illinois


P33D53 - 2013
critical level
Ear-Leaf Fe (ppm @ silking)
140
120
100
80
60
40
20
0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
Ear-Leaf N (% @ silking)
Nebraska
Iowa
Illinois



G x E

How to Normalize Data



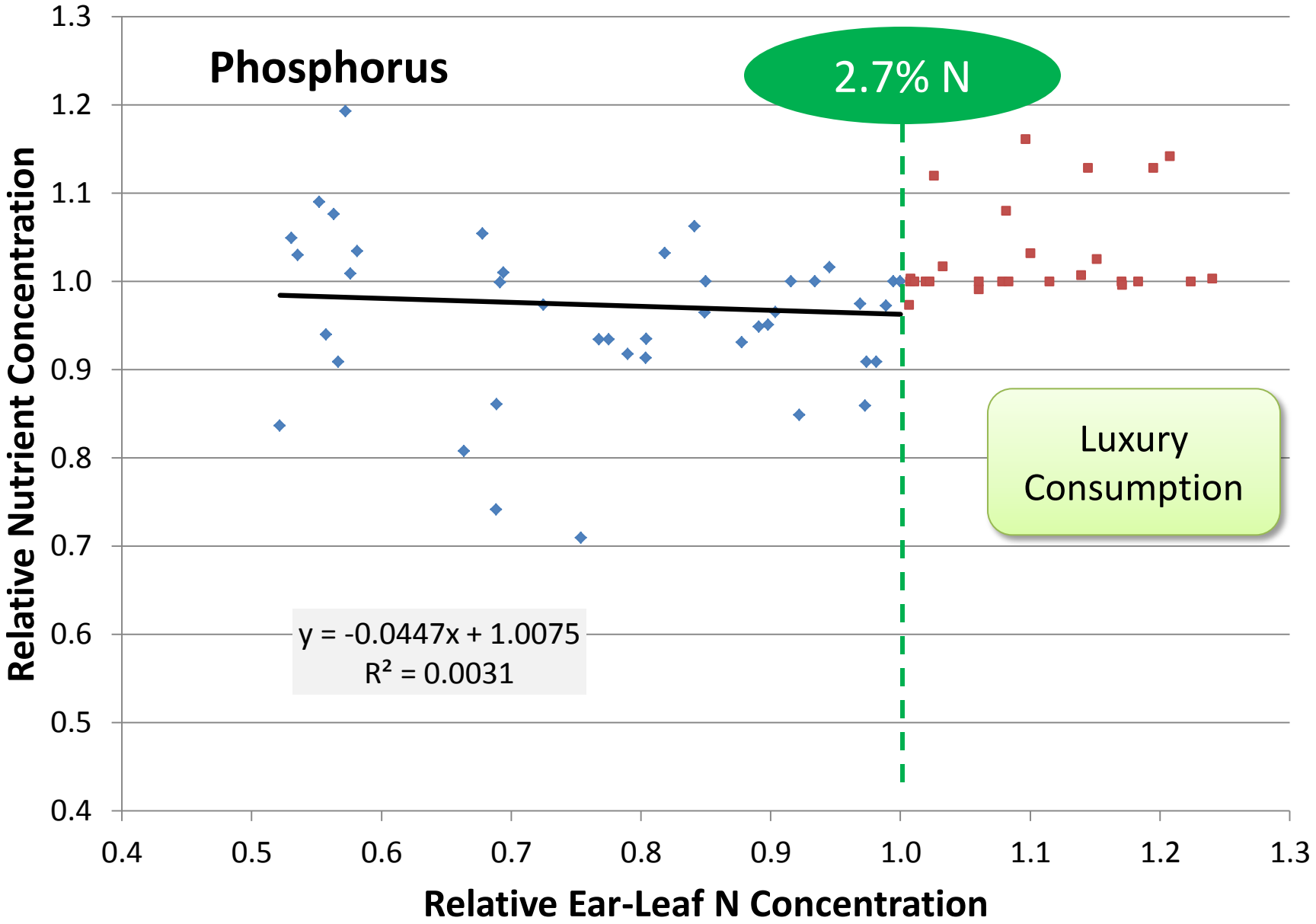
Select a reference

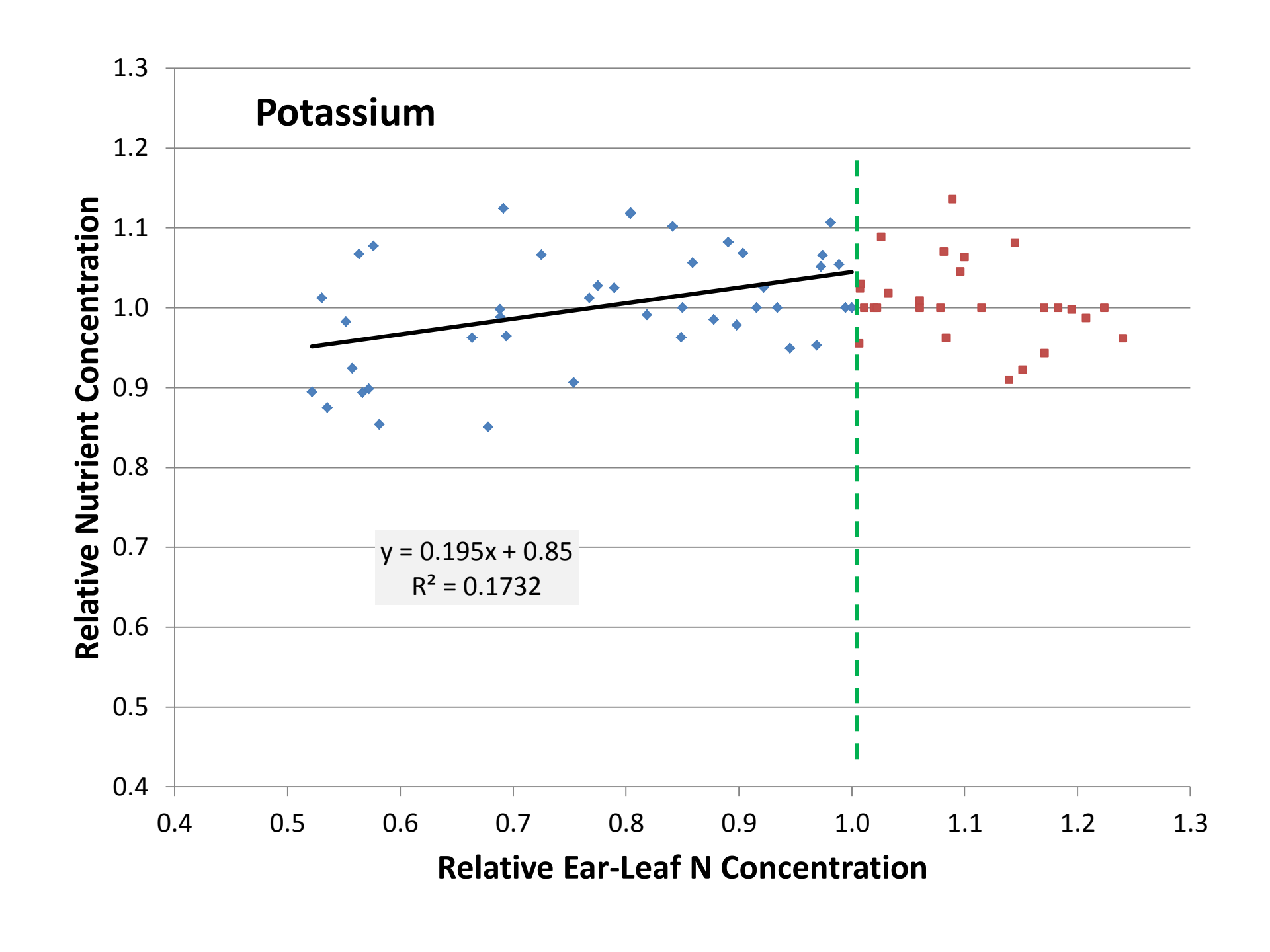
- Highest
- Lowest
- Mean
- Other _____

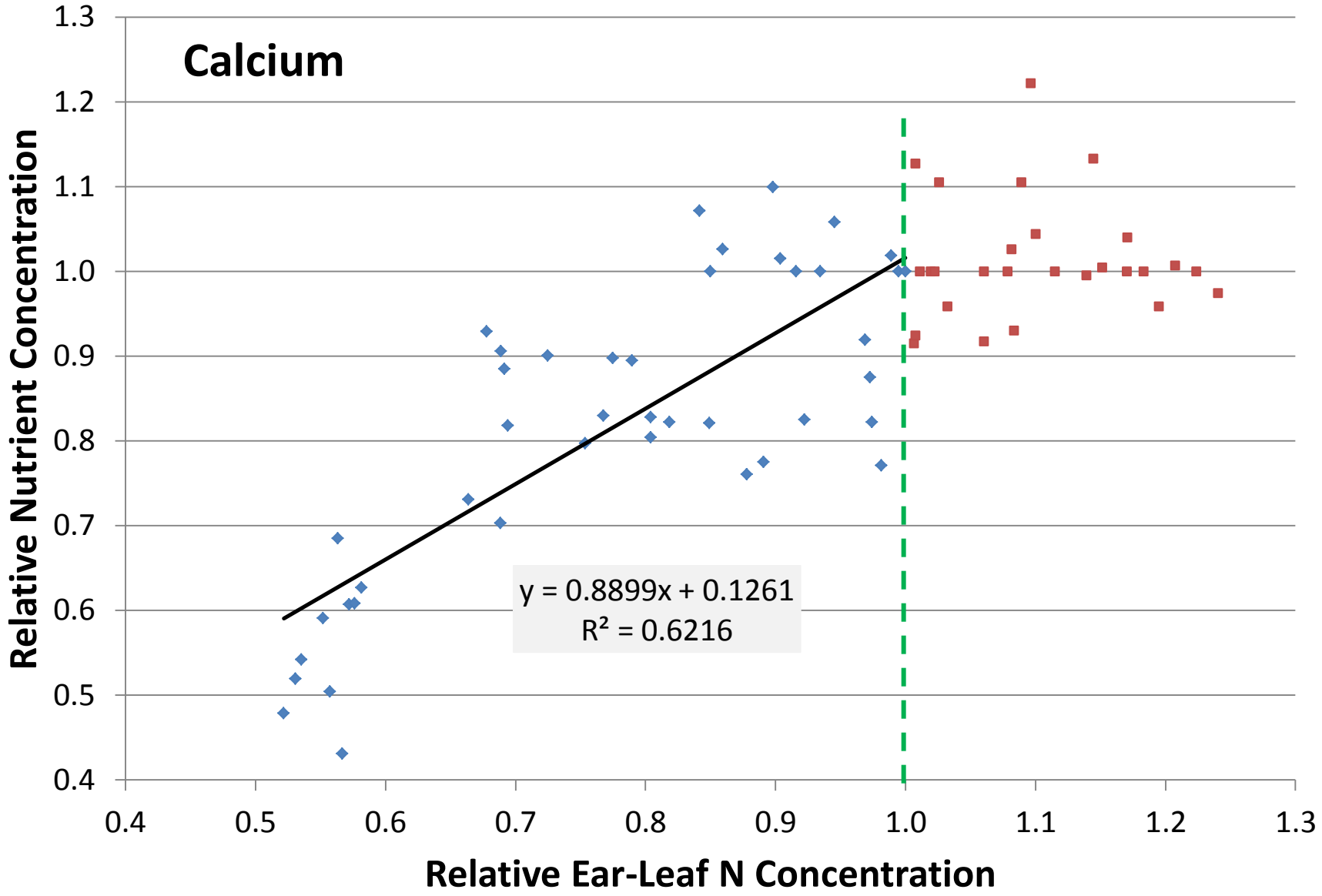
Referenced highest N rate value

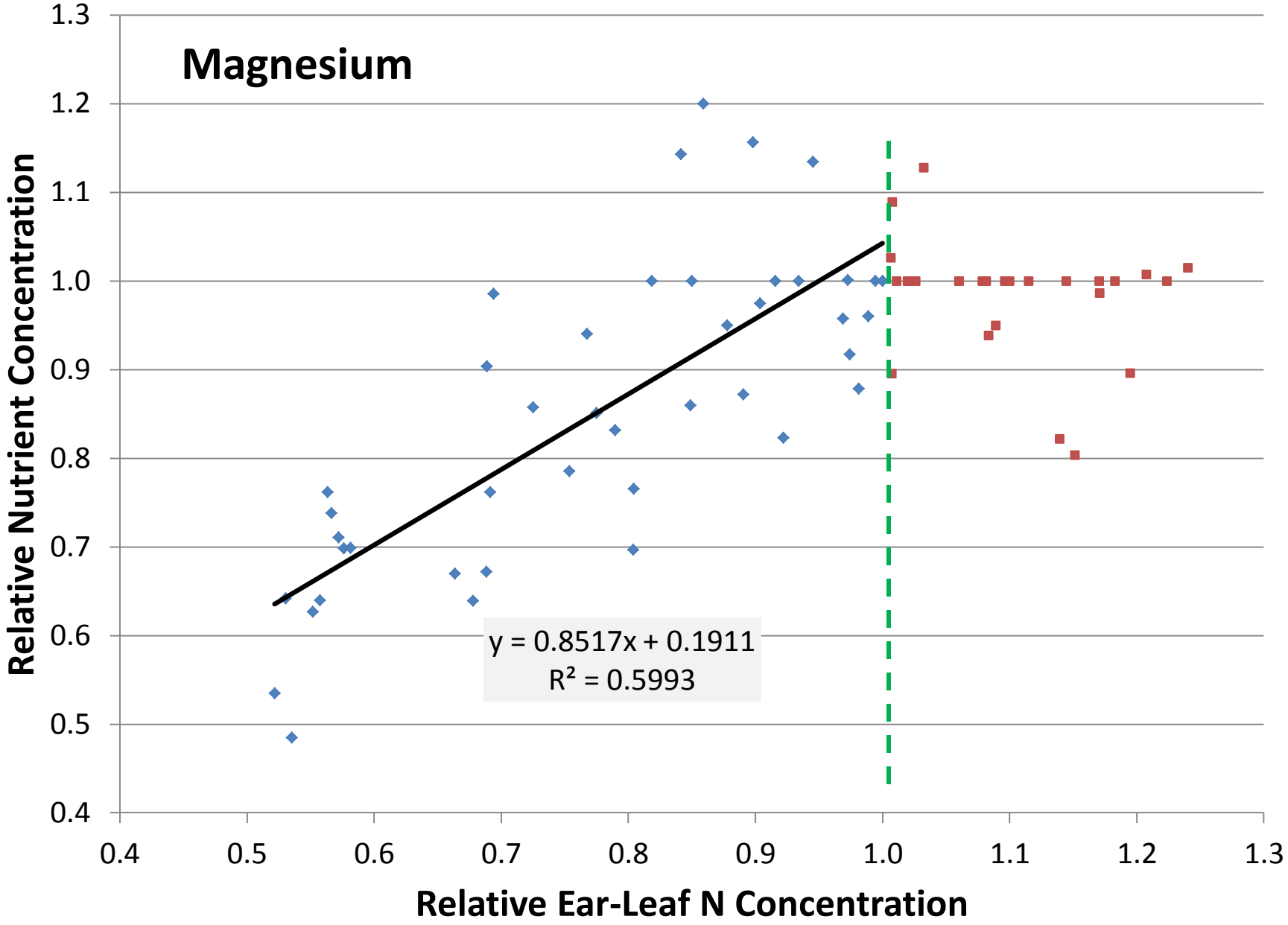
Example:

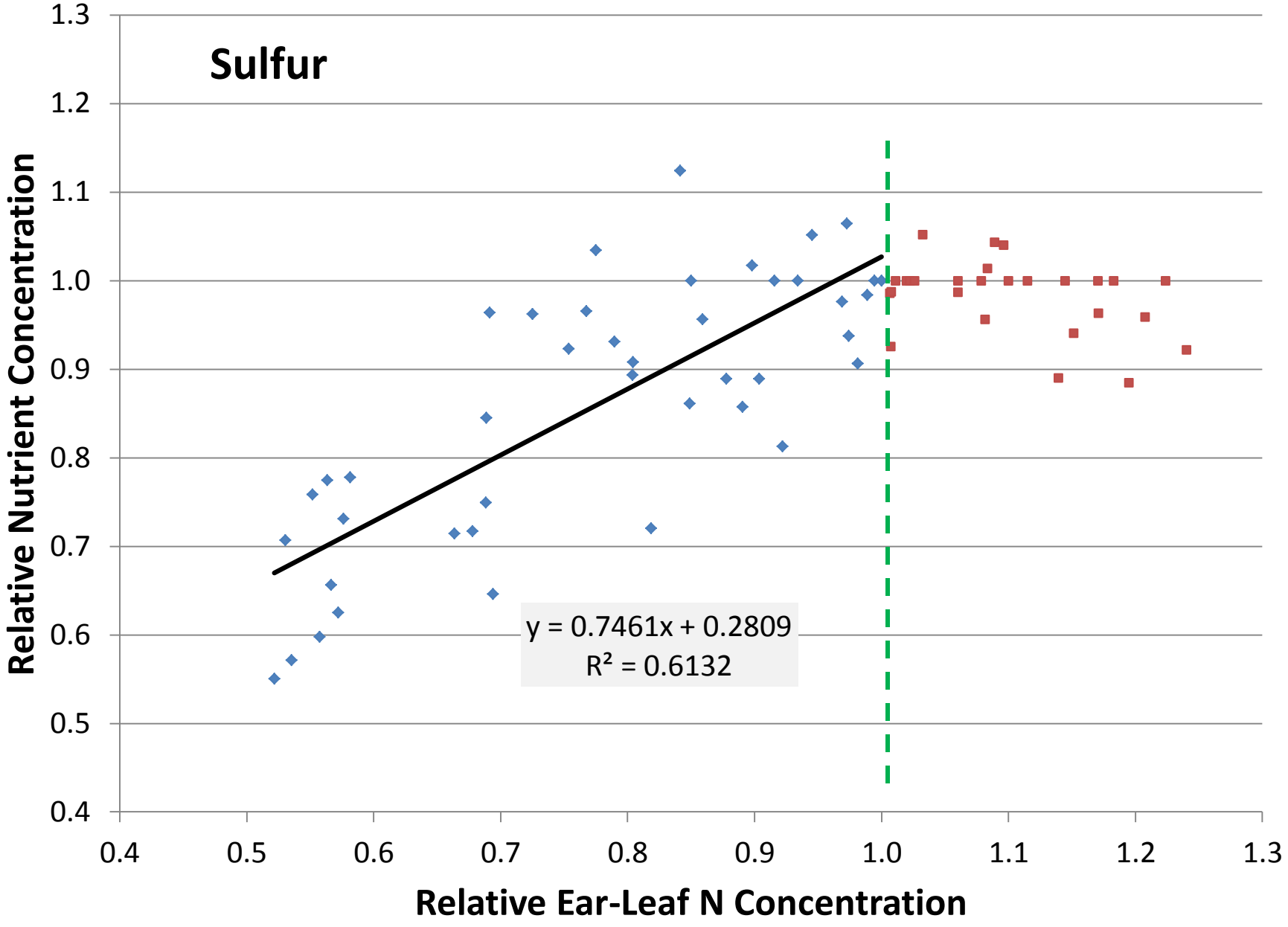
$$\% = \frac{X}{100}$$

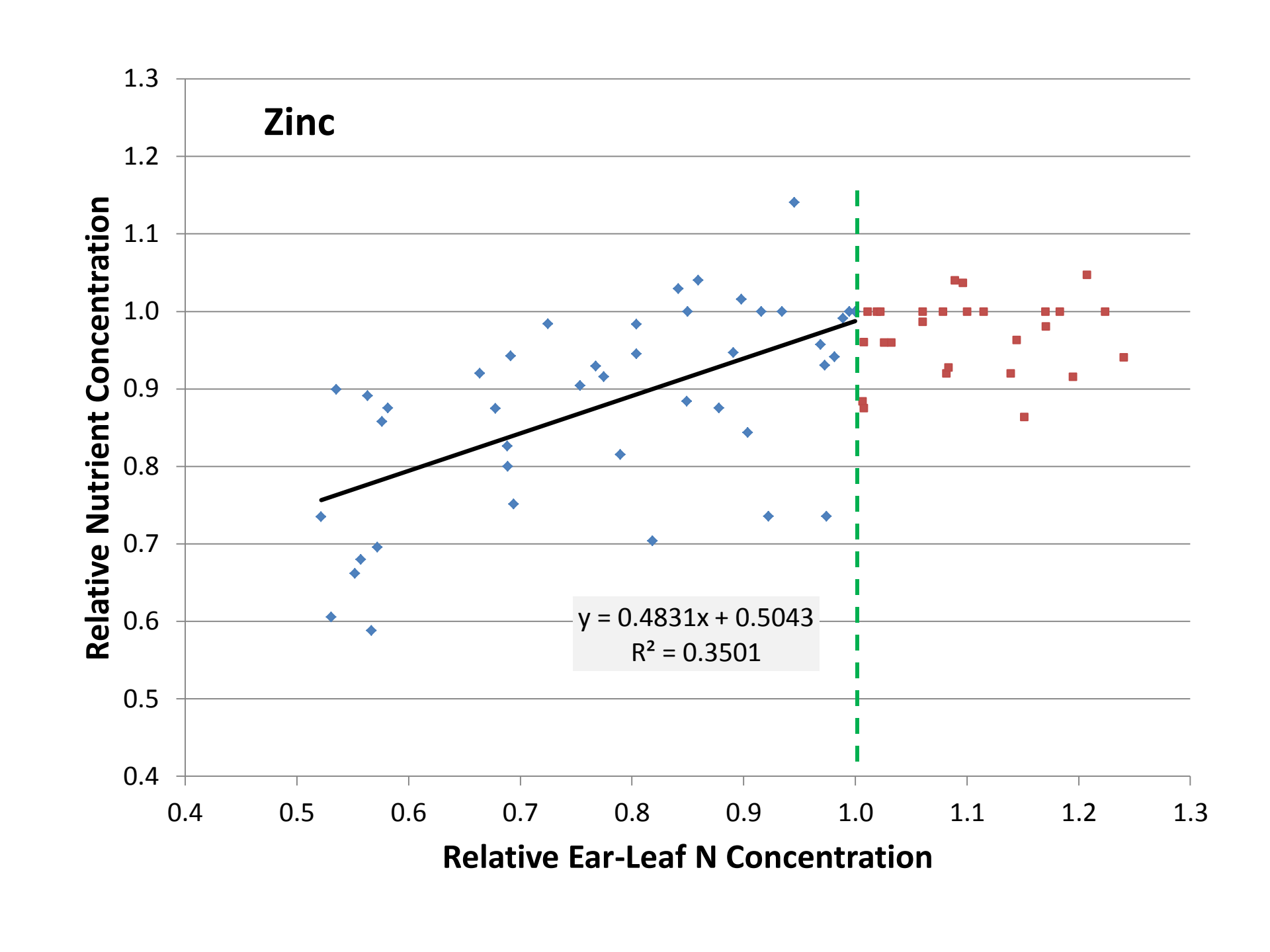

Phosphorus
2.7% N
Luxury Consumption
y = -0.0447x + 1.0075
R² = 0.0031
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

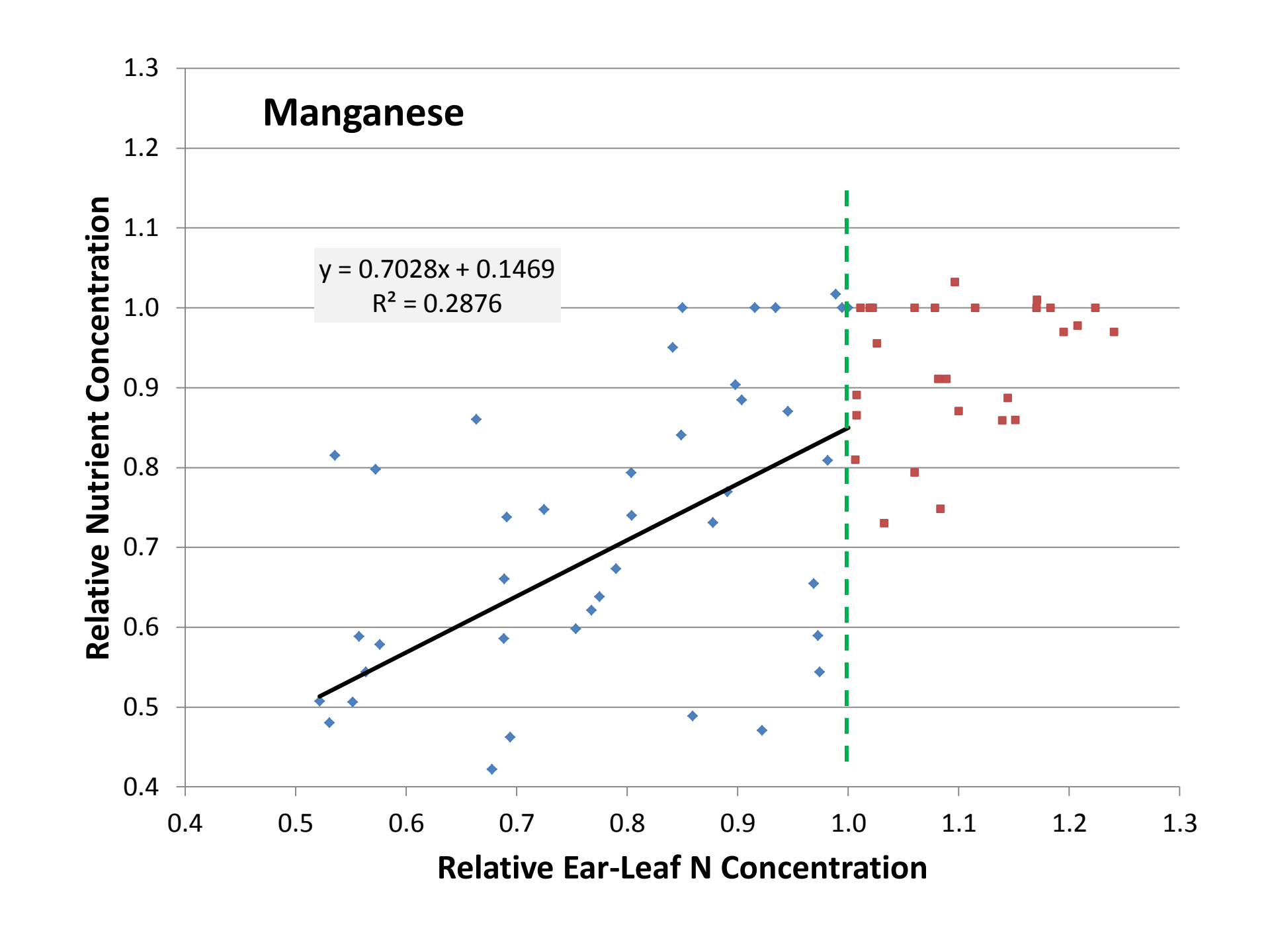

Potassium
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
y = 0.195x + 0.85
R² = 0.1732
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

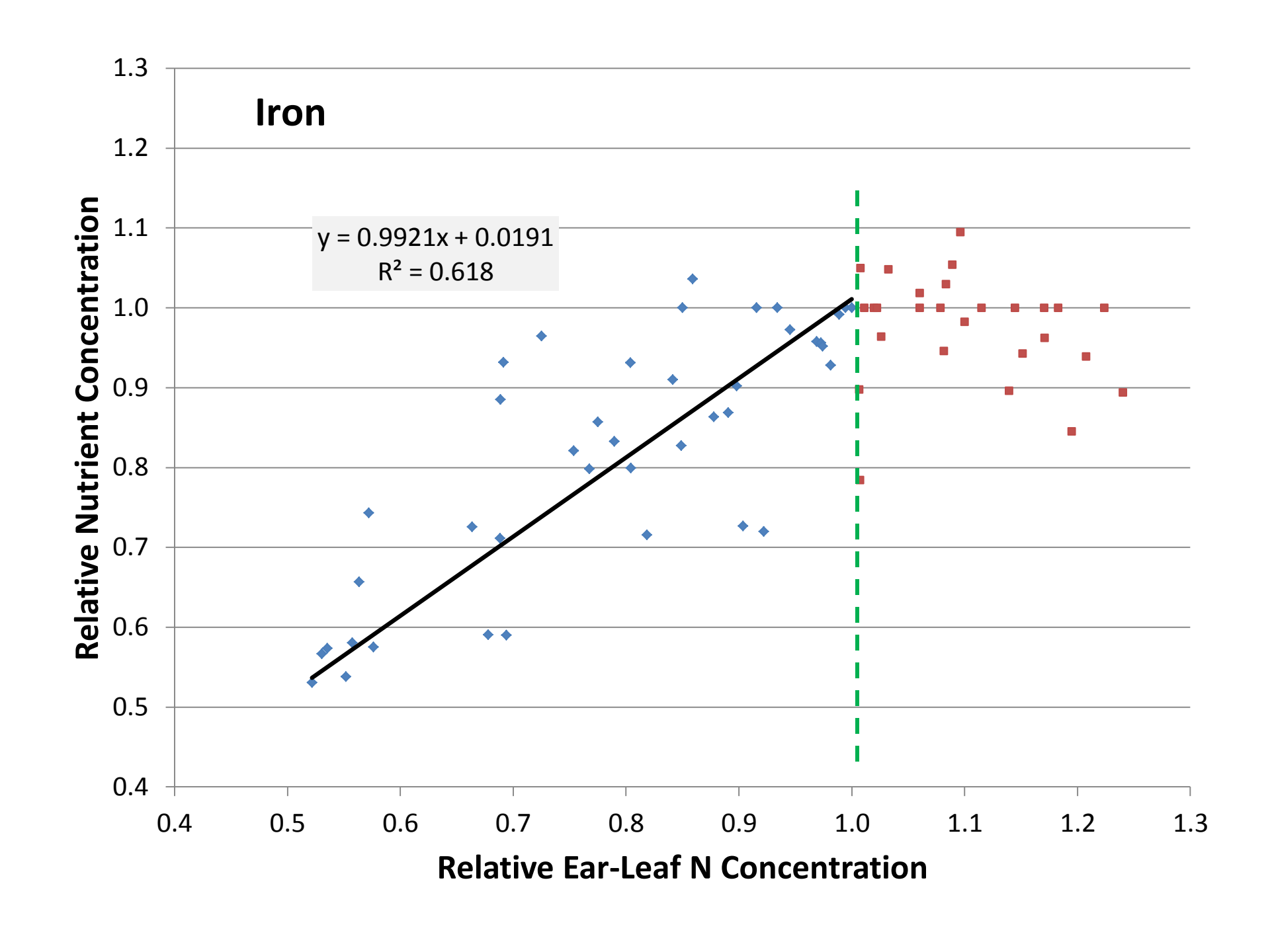

Calcium
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
y = 0.8899x + 0.1261
R² = 0.6216
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

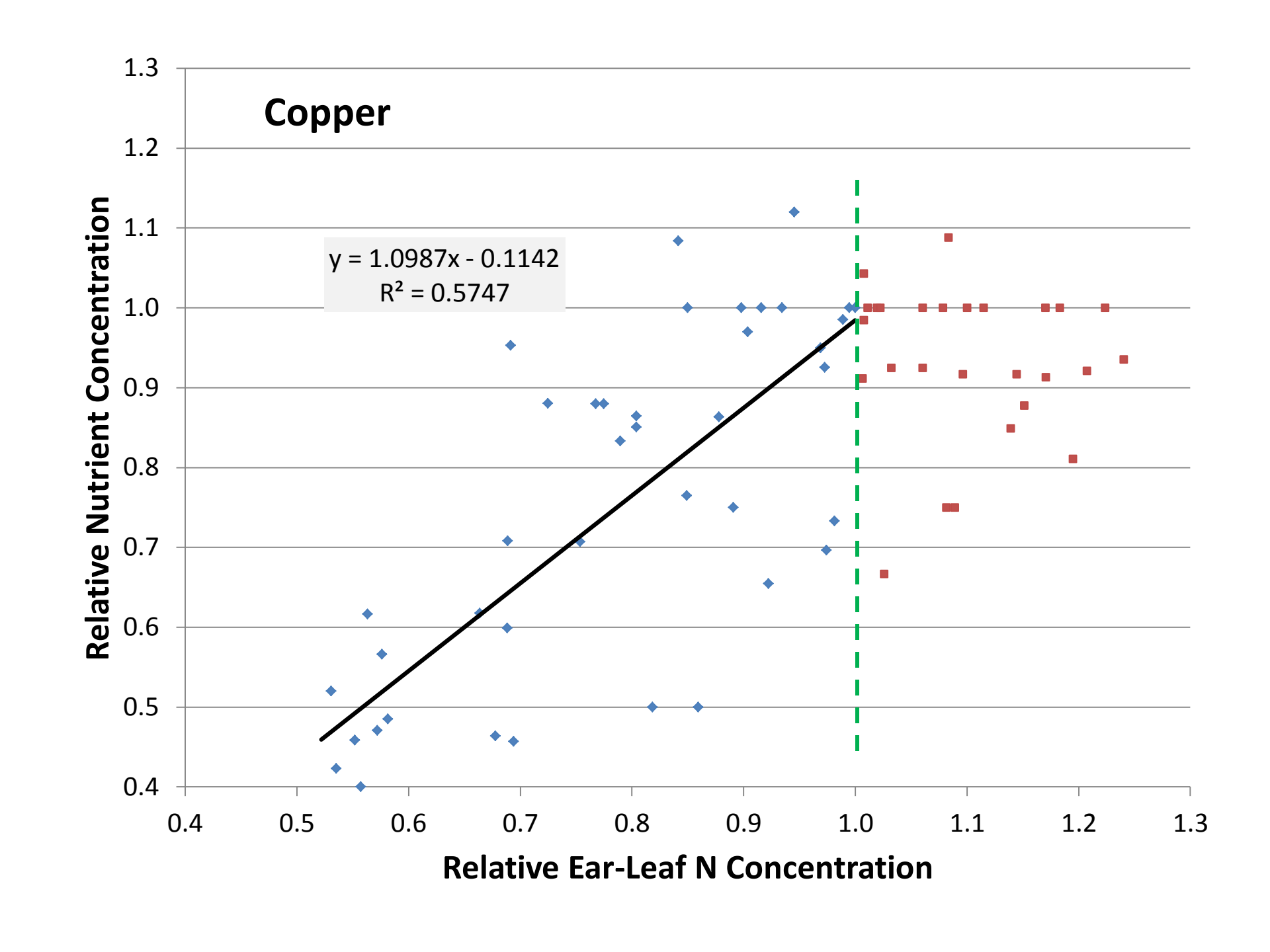

Magnesium
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
y = 0.8517x + 0.1911
R² = 0.5993
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

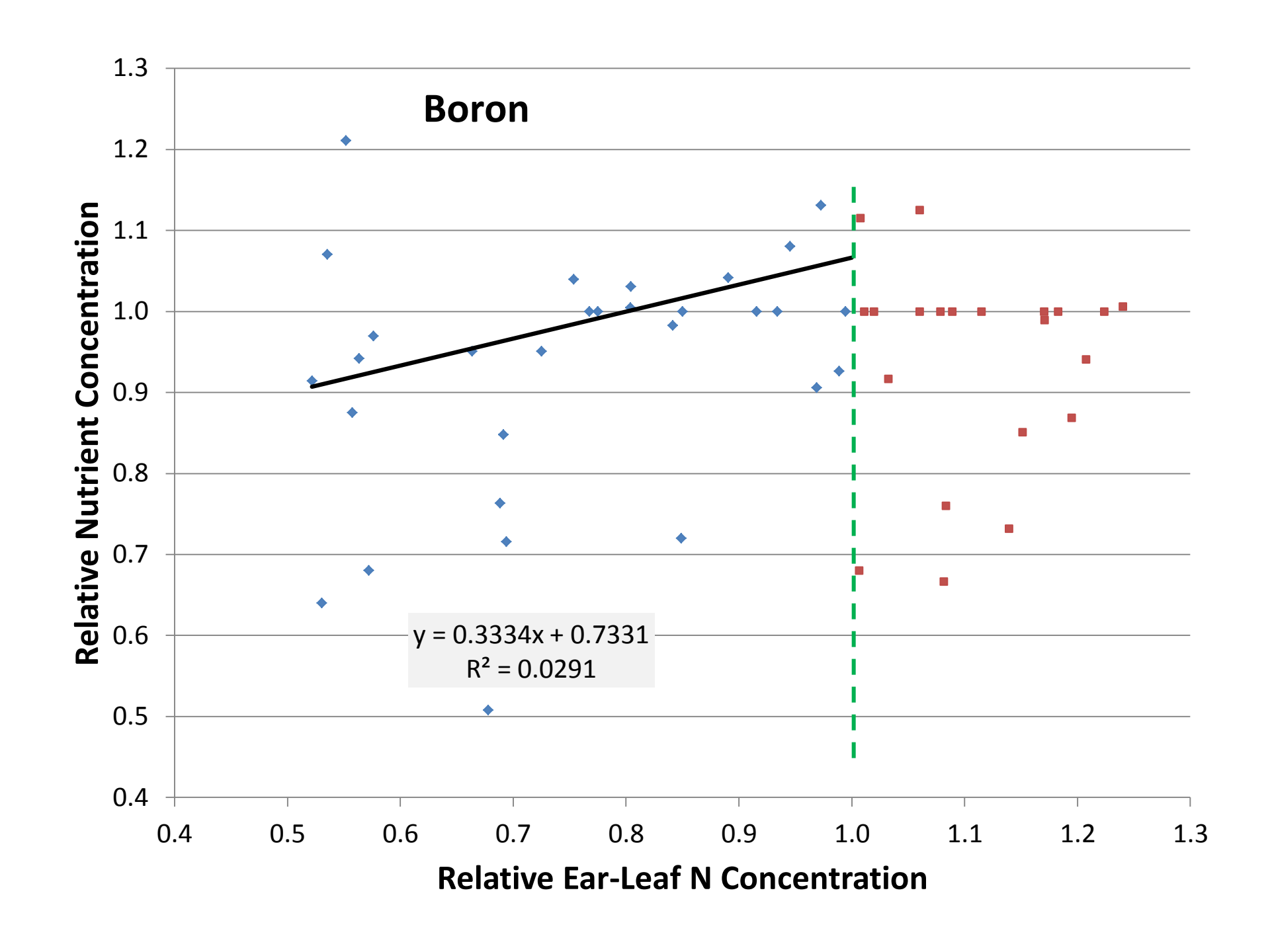

Sulfur
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
y = 0.7461x + 0.2809
R² = 0.6132
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

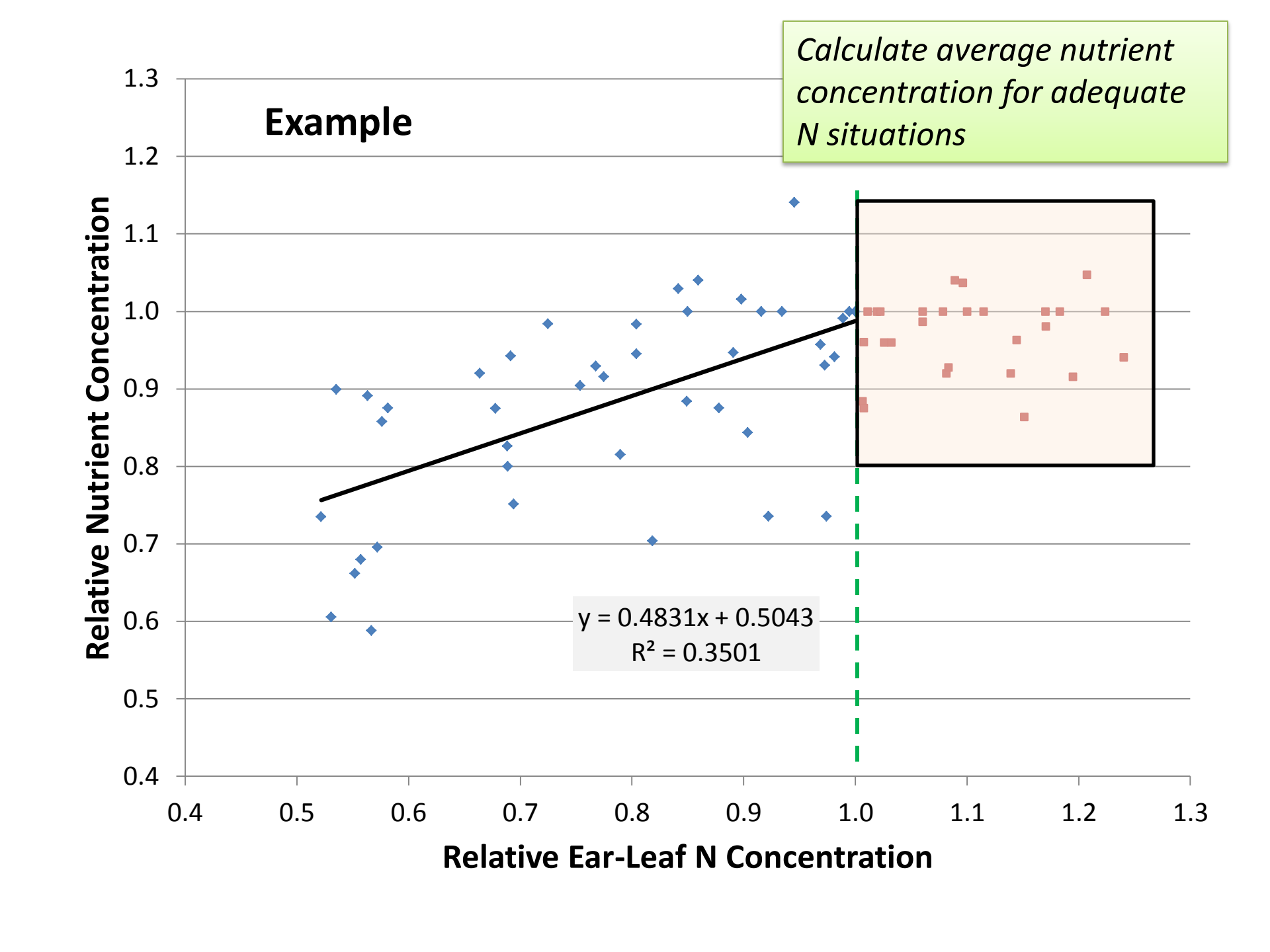

Zinc
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
y = 0.4831x + 0.5043
R² = 0.3501
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3


Manganese
y = 0.7028x + 0.1469
R² = 0.2876
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3


Iron
y = 0.9921x + 0.0191
R² = 0.618
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

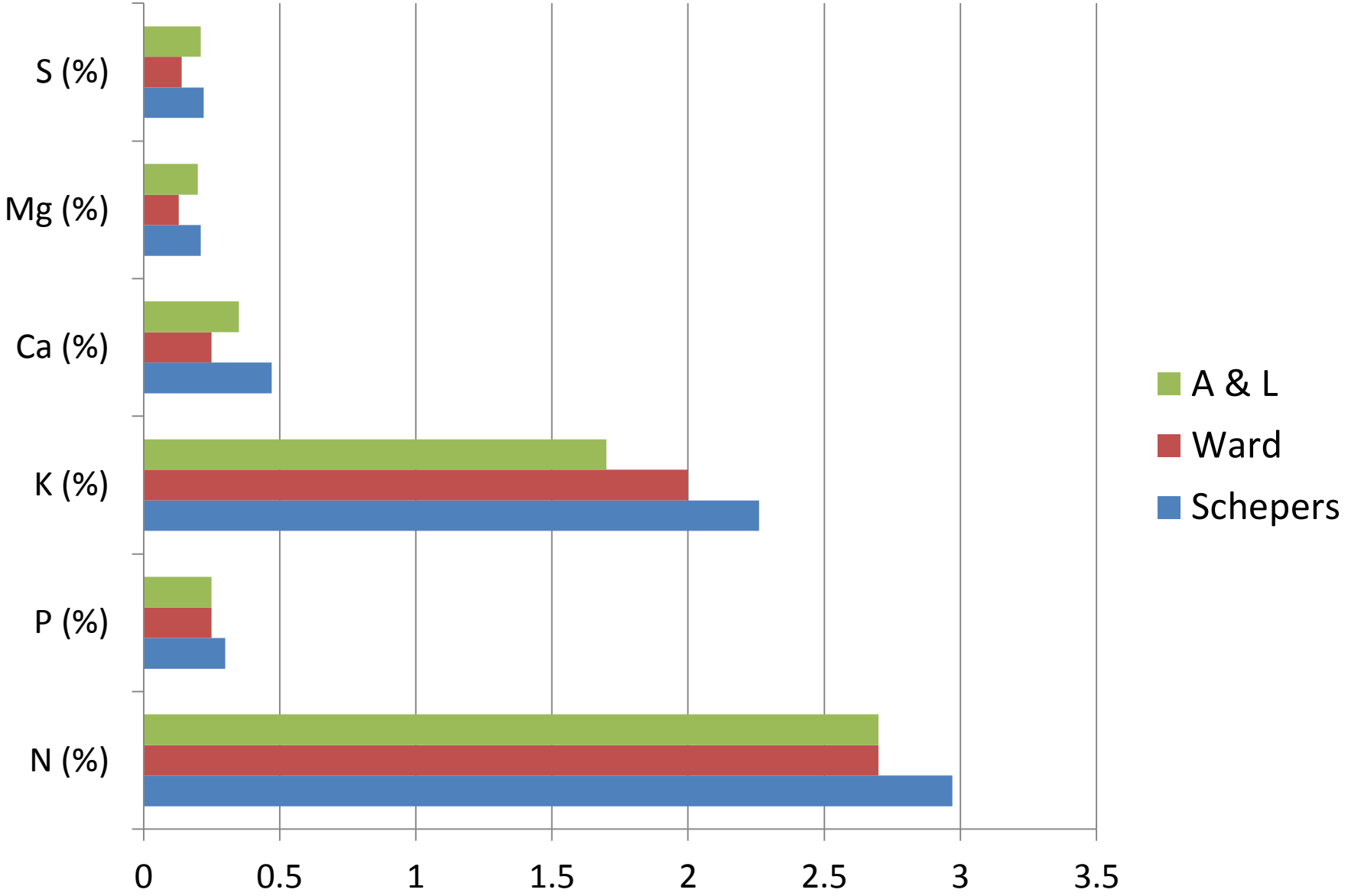

Copper
y = 1.0987x - 0.1142
R² = 0.5747
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

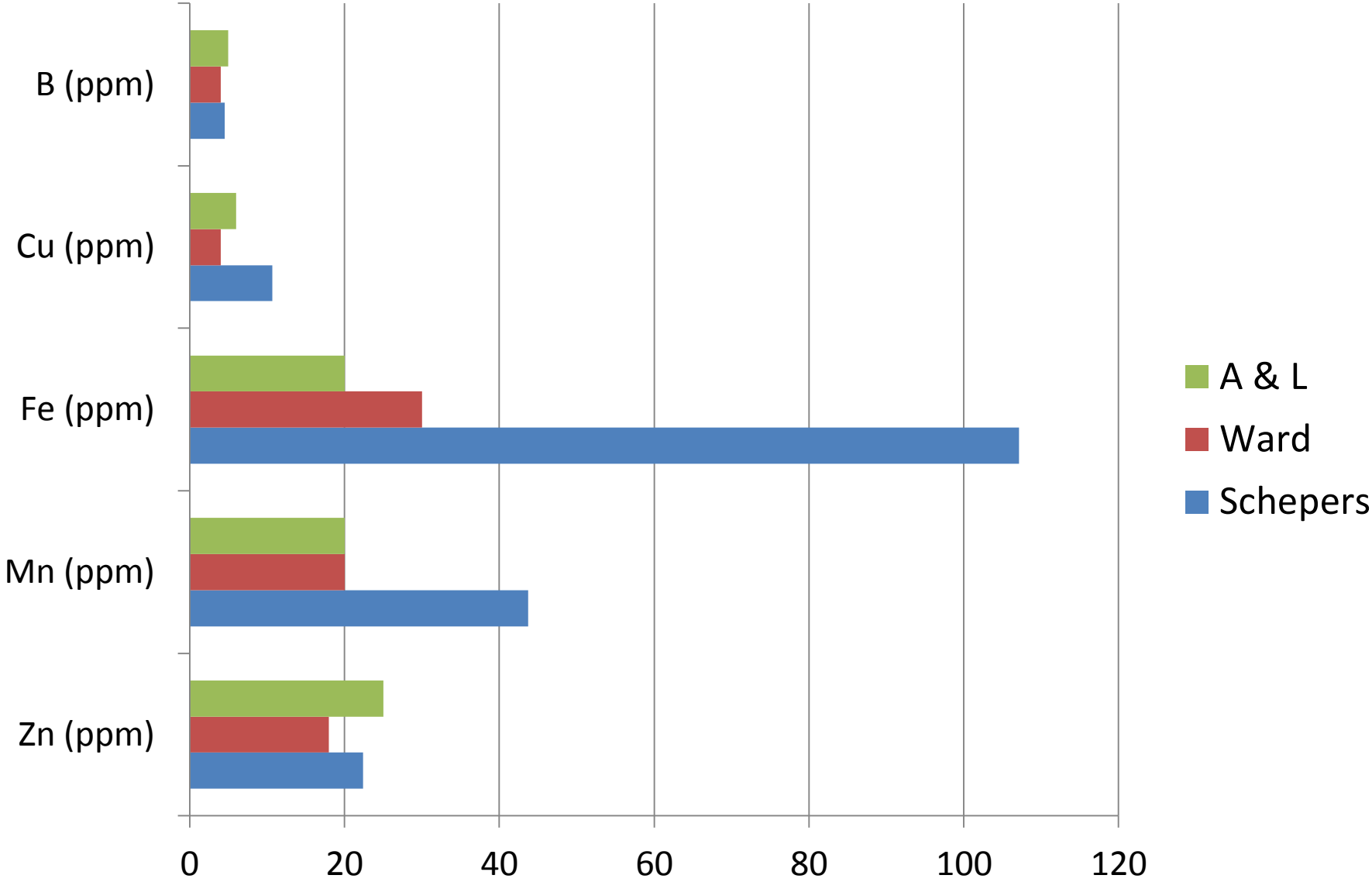

Boron
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
y = 0.3334x + 0.7331
R² = 0.0291
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3


Example
Calculate average nutrient concentration for adequate N situations
Relative Nutrient Concentration
Relative Ear-Leaf N Concentration
y = 0.4831x + 0.5043
R² = 0.3501
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3

Sufficient

Entry	Research Value	C.V. (%)
Yield (bu/A)	187.1	15
N (%)	2.97	7
P (%)	0.30	9
K (%)	2.26	8
Ca (%)	0.47	12
Mg (%)	0.21	30
S (%)	0.22	15
Zn (ppm)	22.4	20
Mn (ppm)	43.7	23
Fe (ppm)	107.1	9
Cu (ppm)	10.7	21
B (ppm)	4.52	35


S (%)
Mg (%)
Ca (%)
K (%)
P (%)
N (%)
0
0.5
1
1.5
2
2.5
3
3.5
A & L
Ward
Schepers


B (ppm)
Cu (ppm)
Fe (ppm)
Mn (ppm)
Zn (ppm)
0
20
40
60
80
100
120
A & L
Ward
Schepers

Implications

Does tissue N concentration also affect concentrations of other nutrients ***earlier in the growing season*** ?

IF SO - are there opportunities for starter fertilizer ?

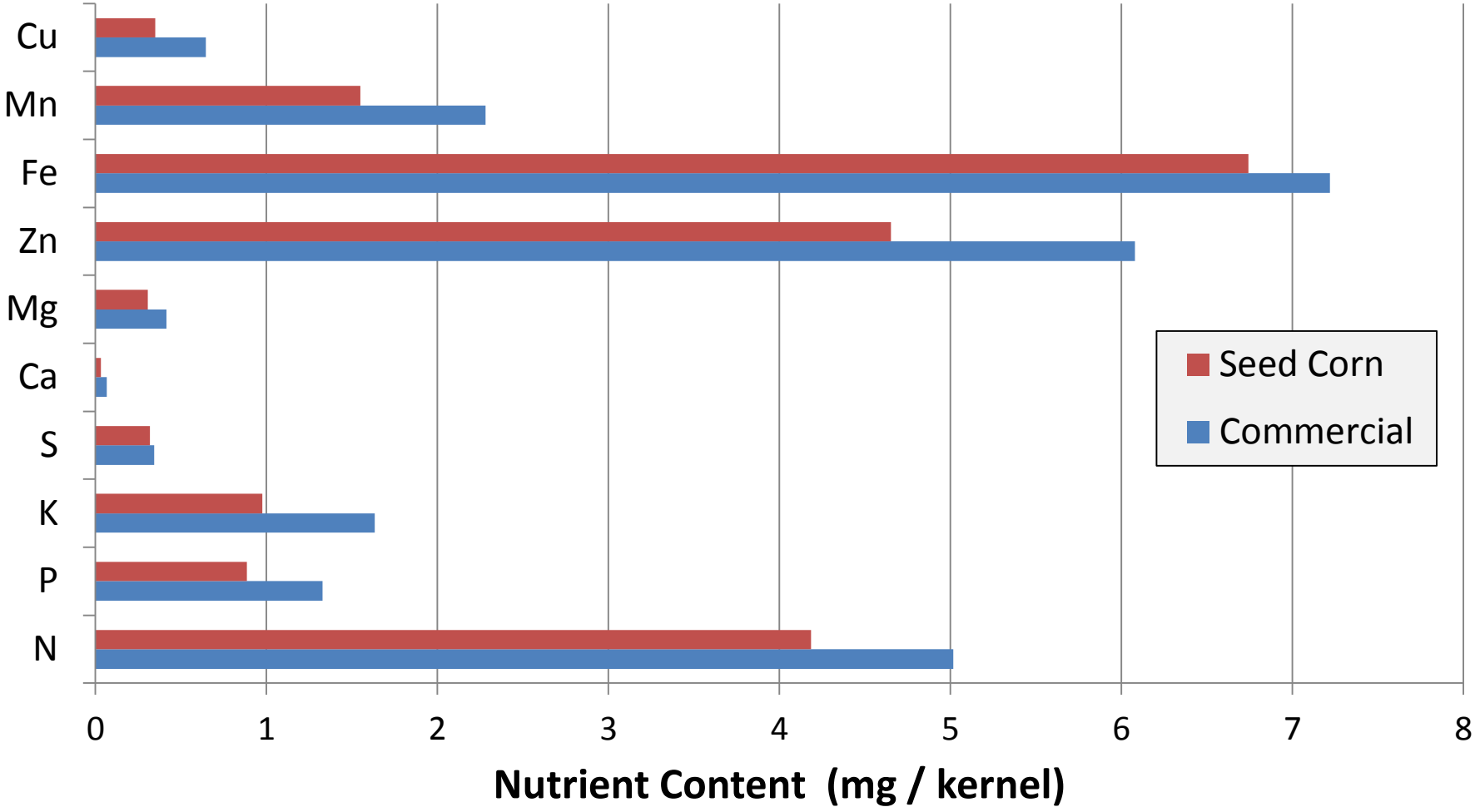
Question - at what growth stage do the nutrients in a kernel of seed corn become exhausted ?

Question - what is the relationship between nutrients, early season vigor, stalk diameter, and yield ?

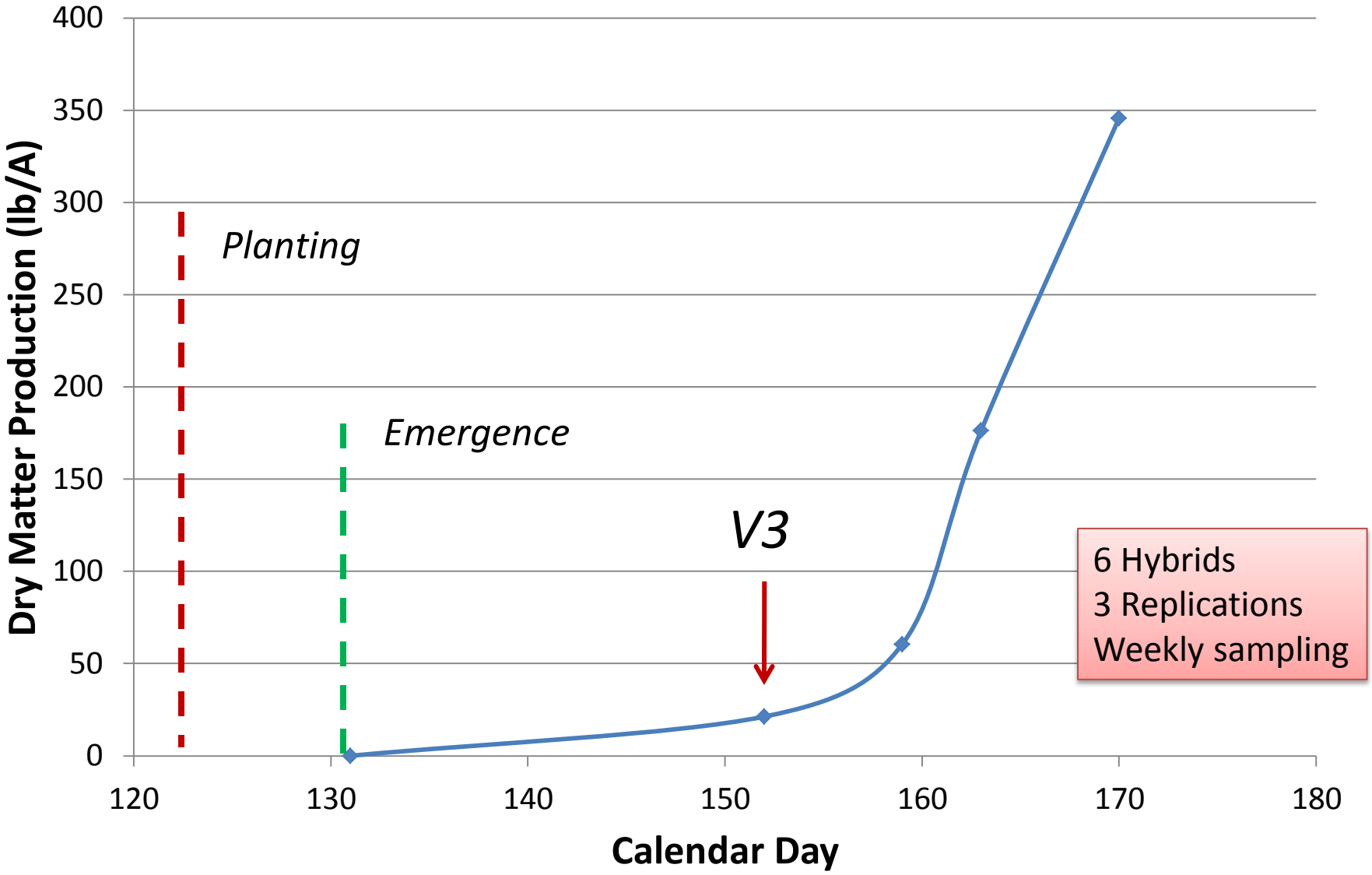
Question - at what growth stage do the nutrients in a kernel of seed corn become exhausted ?

250 mg/kernel

380 mg/kernel


Cu
Mn
Fe
Zn
Mg
Ca
S
K
P
N
0
1
2
3
4
5
6
7
8
Seed Corn
Commercial
Nutrient Content (mg / kernel)

Above-ground Dry Matter Production of Corn Seedlings



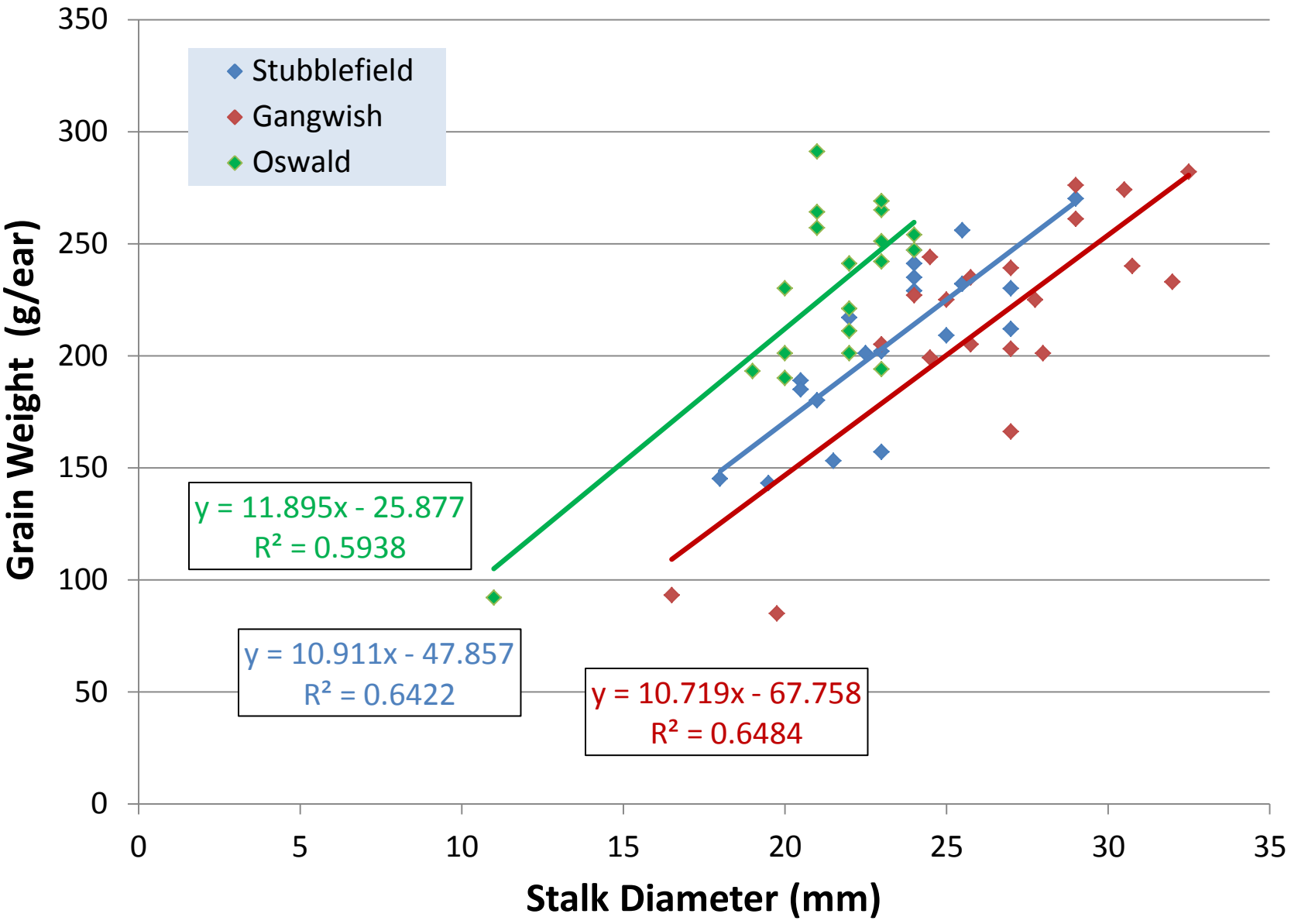
How long will kernel nutrients last ?

Nutrient	*Days**
N	6.8
P	11.9
K	1.2
S	7.9
Mg	11.8
Ca	0.5
Fe	2.3
Zn	7.0
Mn	2.1
Cu	2.8

Any Surprises ?

** Days after emergence*

Question - what is the relationship between nutrients, early season vigor, stalk diameter, and yield ?


Stubblefield
Gangwish
Oswald
y = 11.895x - 25.877
R² = 0.5938
y = 10.911x - 47.857
R² = 0.6422
y = 10.719x - 67.758
R² = 0.6484
Grain Weight (g/ear)
Stalk Diameter (mm)
0
50
100
150
200
250
300
350
0
5
10
15
20
25
30
35

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A & L Great Lakes Lab - *Randall Warden* -