University of California
Agriculture and Natural Resources

Improving Irrigation and Nutrient Management

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Objectives

- Fill gaps in nutrient and water management data
- Devise CropManage for onions

CropManage

ucanr.org/cropmanage

Database driven web application

Crop ET model

Crop N model

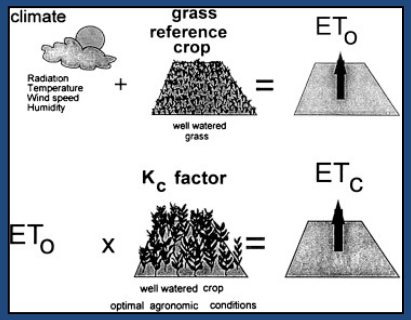
Crops:
Lettuce, broccoli, cauliflower, cabbage, celery, salad greens, peppers, caneberries

How is irrigation rate determined?

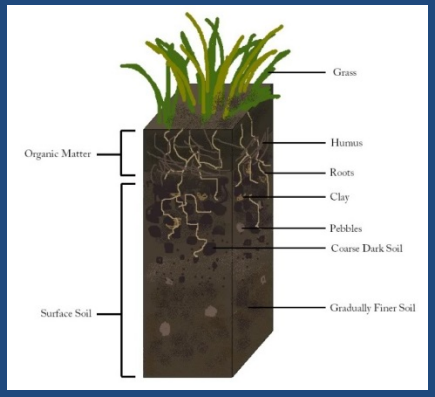
Cimis, ETo

Kc

ETc



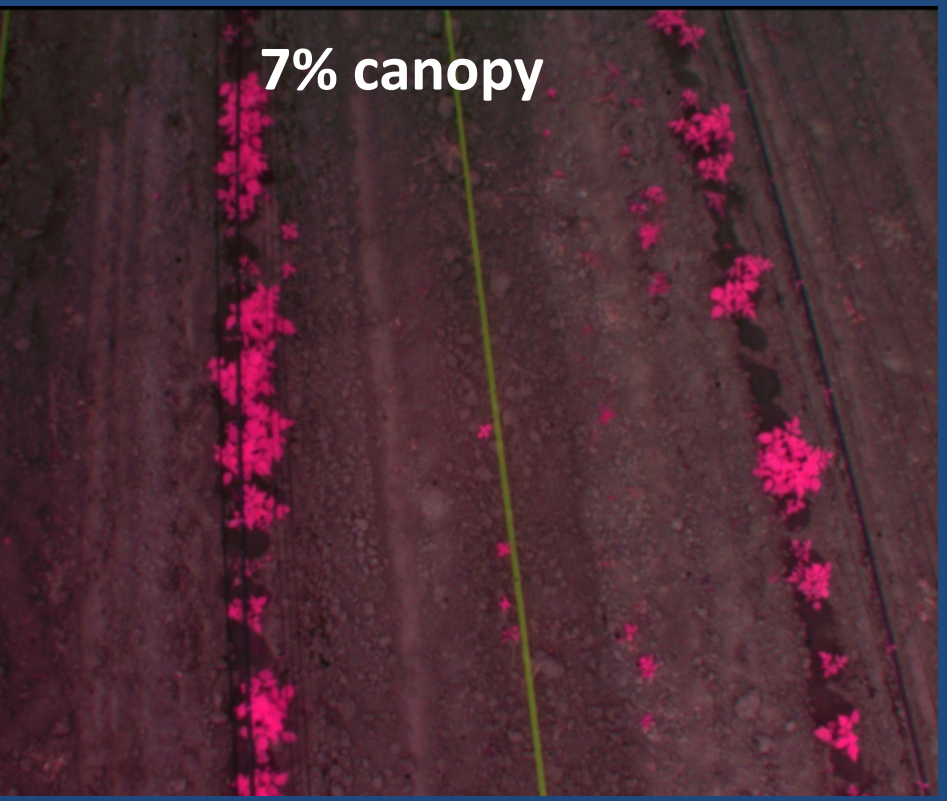
Water recommendation

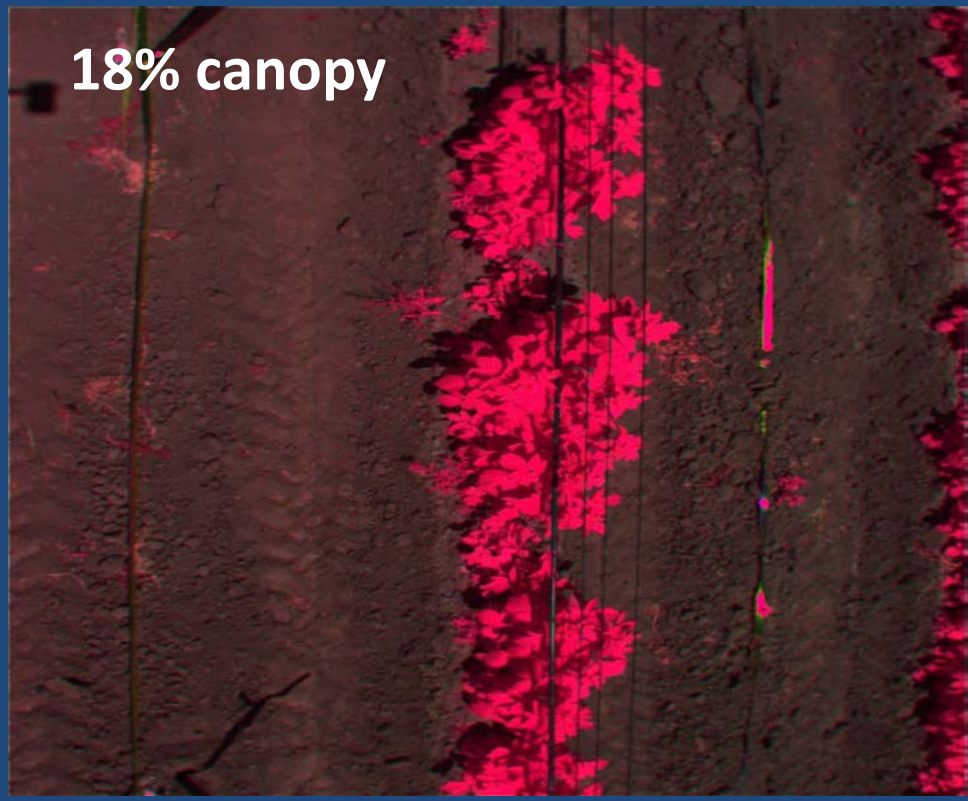


- Allowable depletion
- Irrigation system application rate
- Irrigation system application uniformity
- Leaching fraction (water salinity)
- And more

$$ET_{crop} = ET_o \times K_c$$

K_c can vary from 0.1 to 1.2





How is N fertilizer rate determined?

Fertilizer N = Crop N uptake – Soil N

Soil N:

– Quick Test N (ppm NO_3-N)

– Soil mineralization N

Crop uptake???

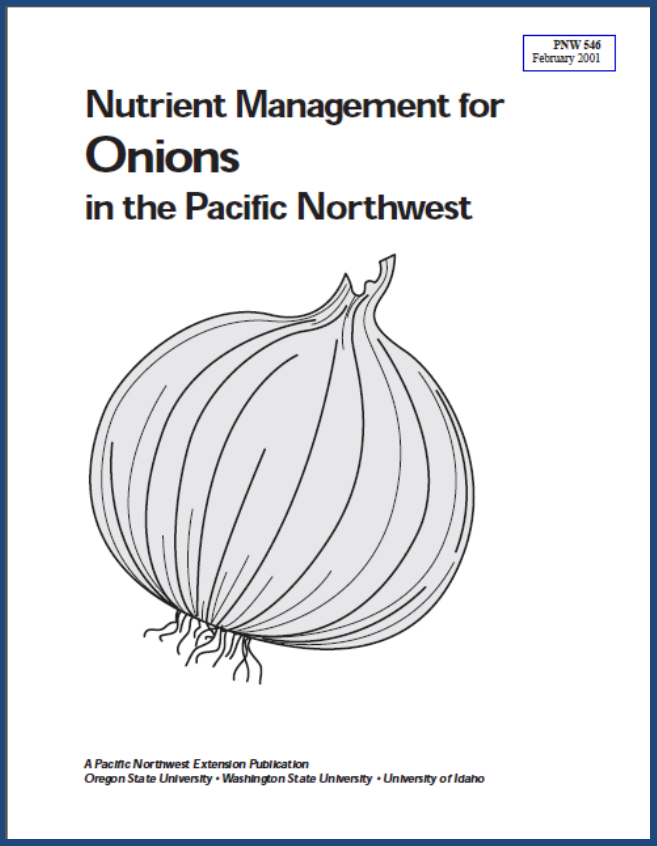
Nitrogen and Water Management in Onion Production

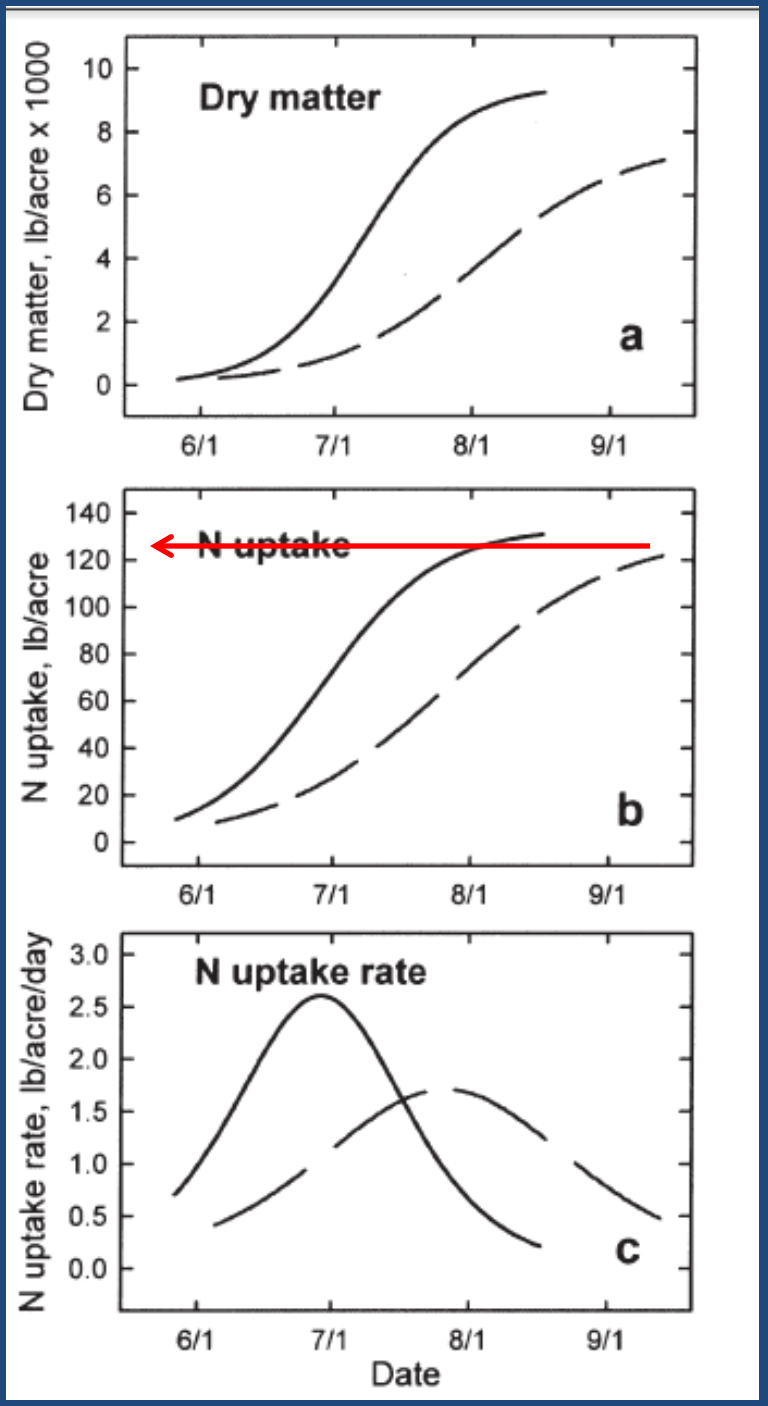
- ✓ Successful water and nitrogen management = maximum yields and quality of onions

- ✓ Proposed changes in water quality regulations in California in recent years = increasing efficiency of nitrogen fertilizer use

N Uptake Information

- Nutrient uptake information for onion production in California is very limited
- Information created for the Pacific Northwest


PNW 546
February 2001
Nutrient Management for
Onions
in the Pacific Northwest
A Pacific Northwest Extension Publication
Oregon State University • Washington State University • University of Idaho

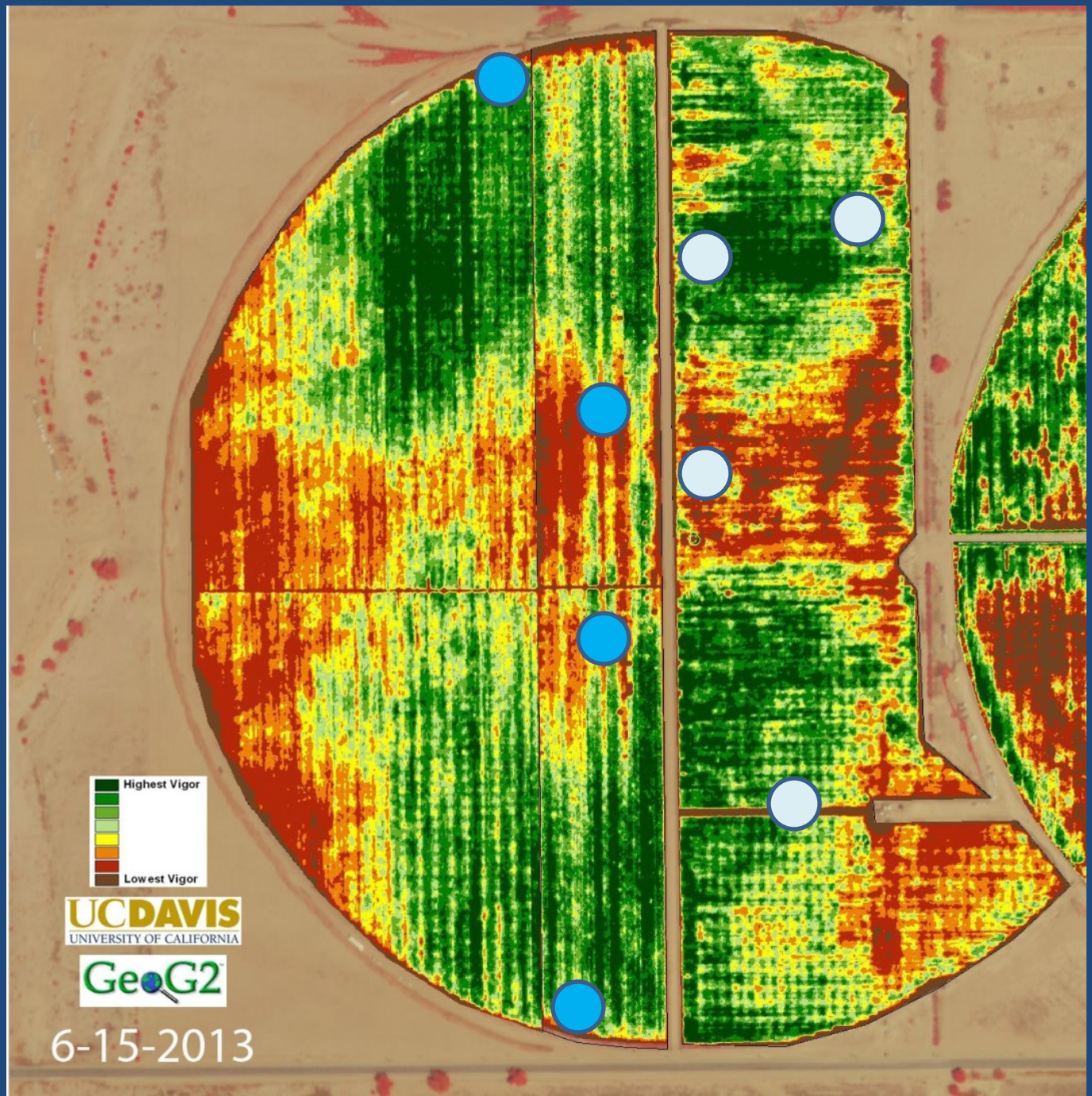

Dry matter
Dry matter, lb/acre x 1000
10
8
6
4
2
0
a
6/1
7/1
8/1
9/1
N uptake
N uptake, lb/acre
140
120
100
80
60
40
20
0
b
N uptake rate
N uptake rate, lb/acre/day
3.0
2.5
2.0
1.5
1.0
0.5
0.0
c
Date

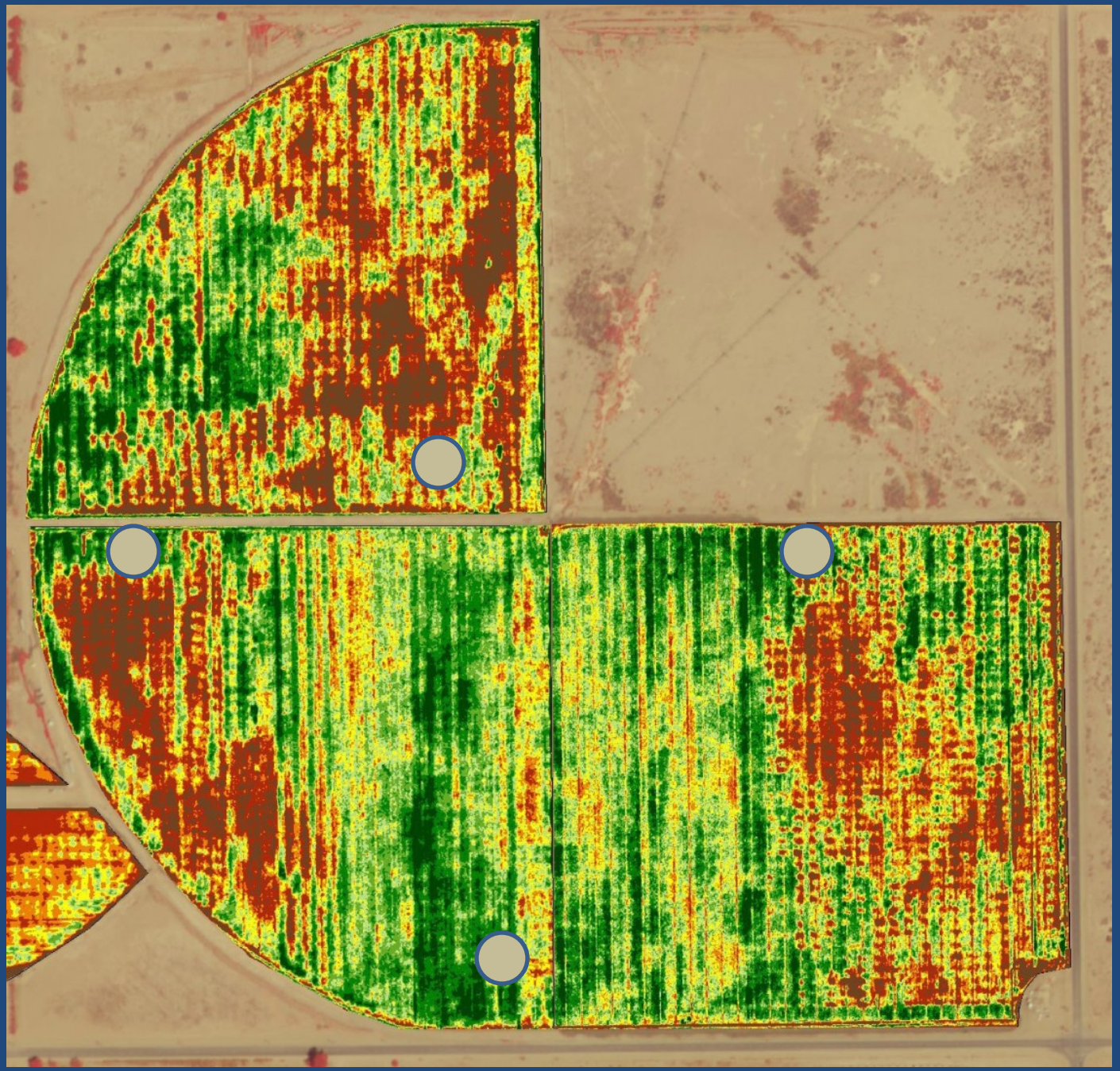
Measurements

- 3 onion fields; 3 varieties (A, B and C)
- 4 sampling locations per field/variety

Weekly:

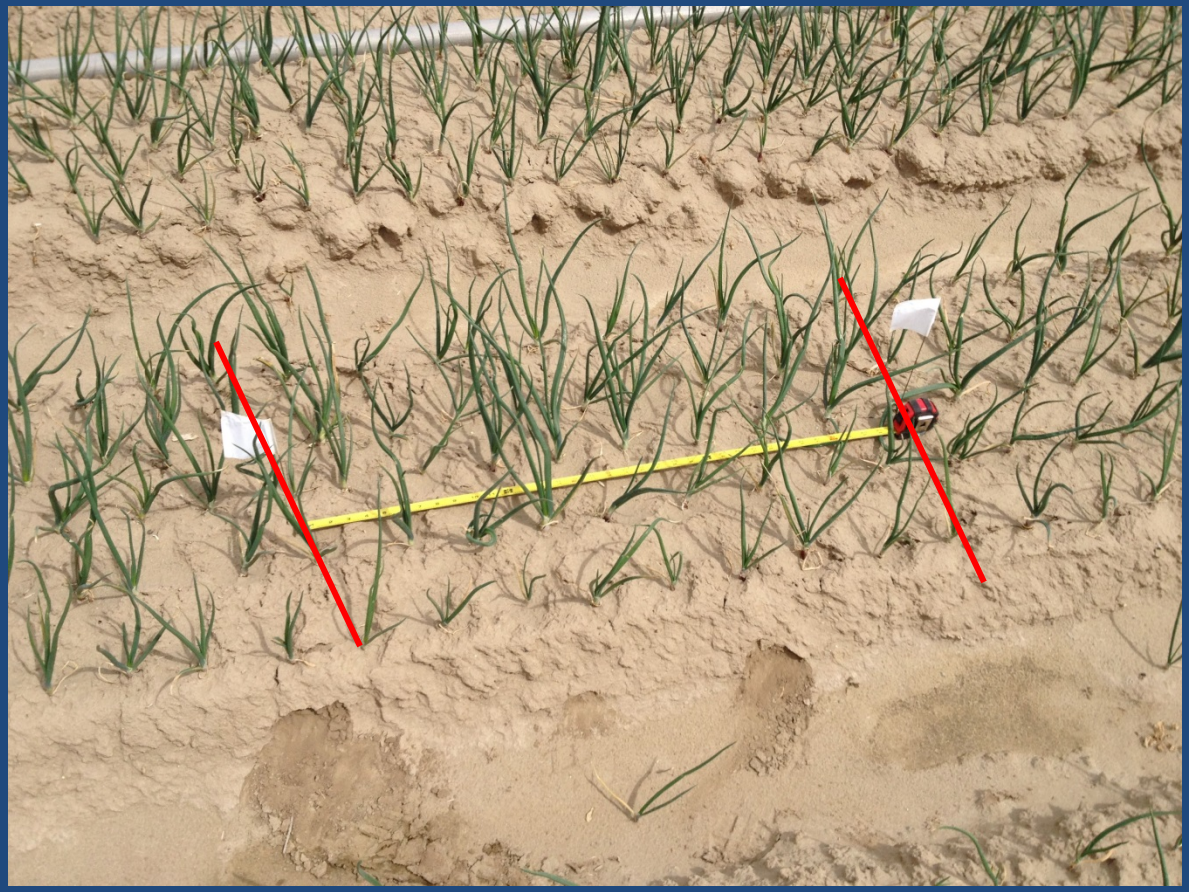
- Biomass samples
- Nutrient content (NPK) for uptake curves
- Canopy coverage (%)
- Root depth
- Growth state
- Number of plants
- Yield


Highest Vigor
Lowest Vigor
UCDAVIS
UNIVERSITY OF CALIFORNIA
GeoG2
6-15-2013



Biomass sampling

- 3ft of the bed

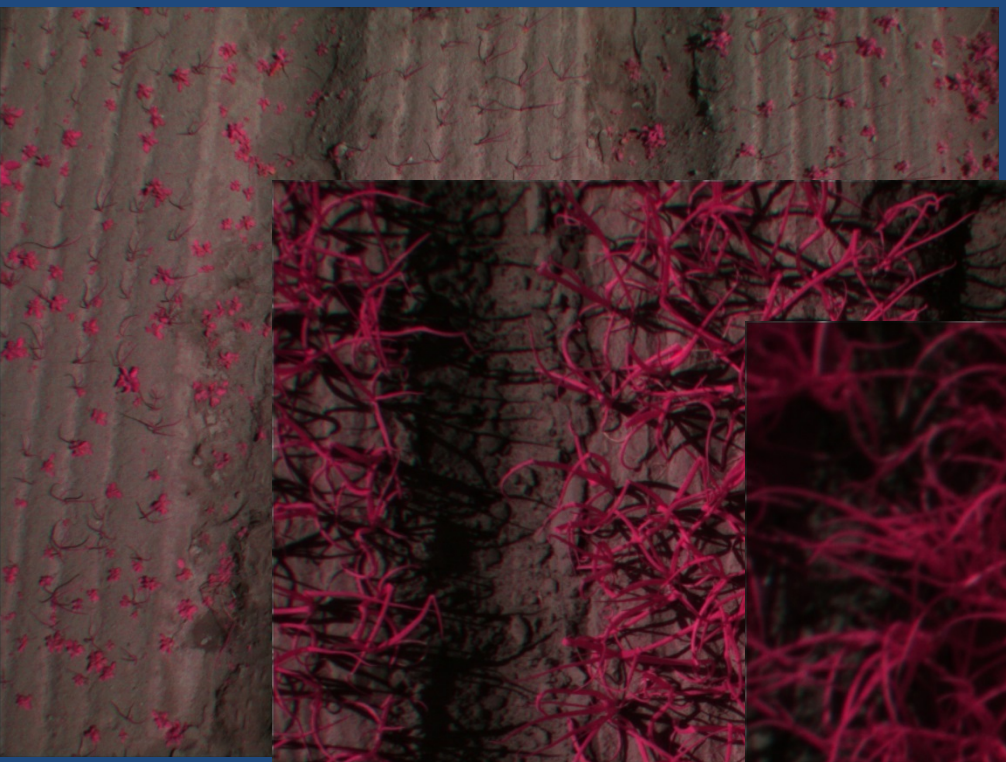


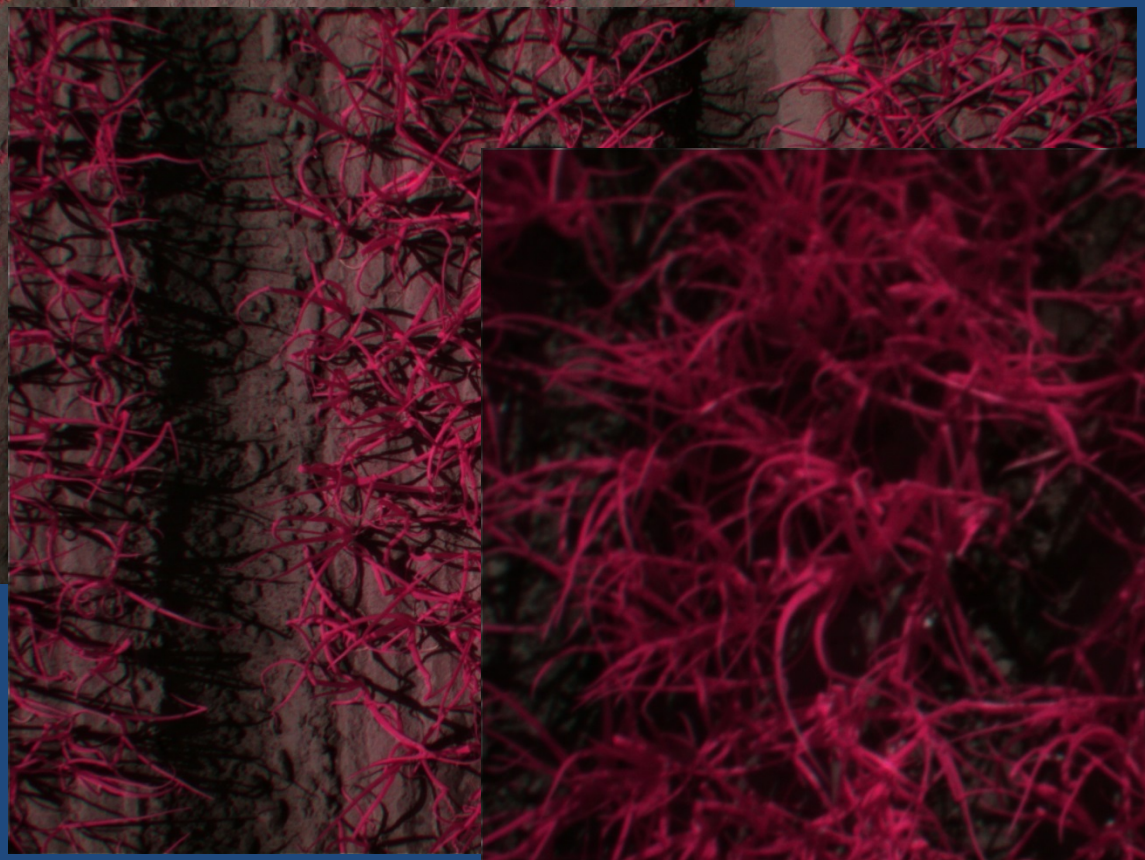
Laboratory analysis - NPK

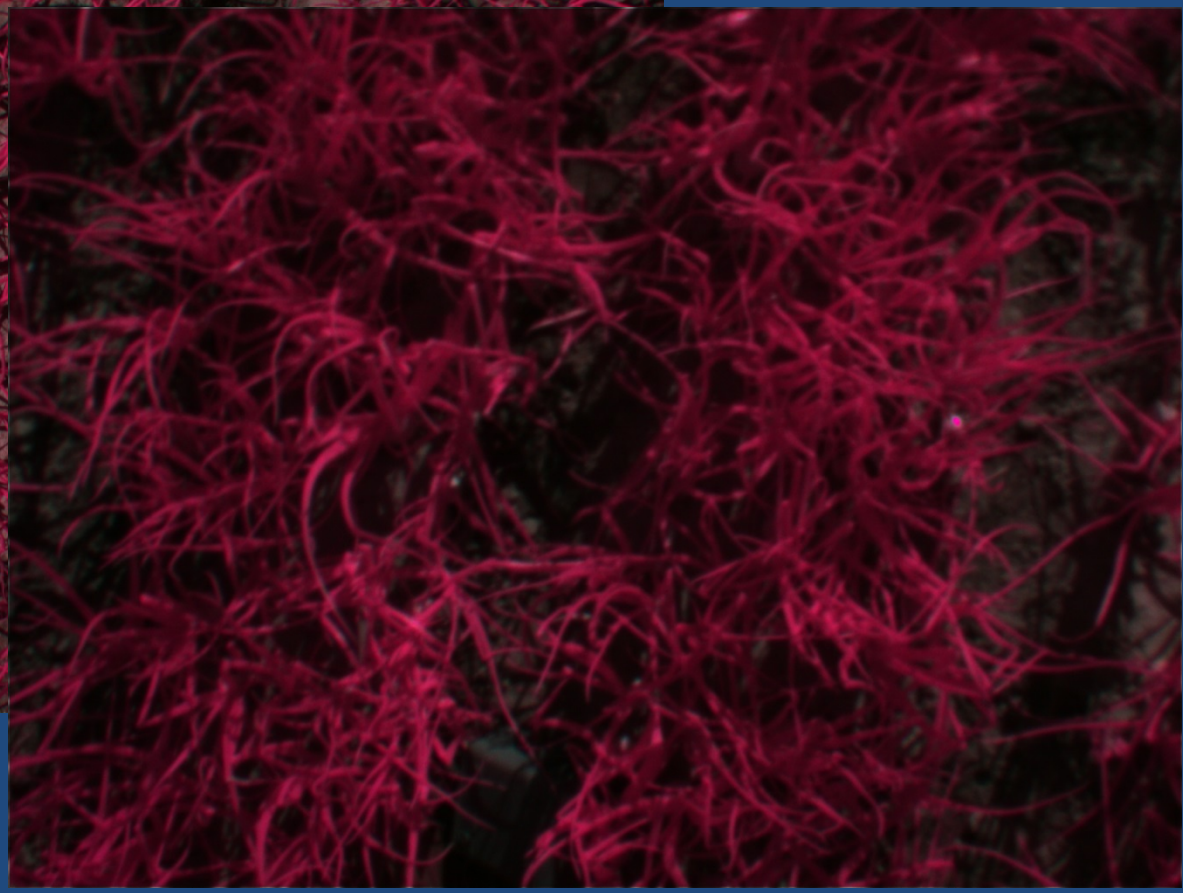
Canopy Cover

- Infra-red camera

Infra-Red Pictures



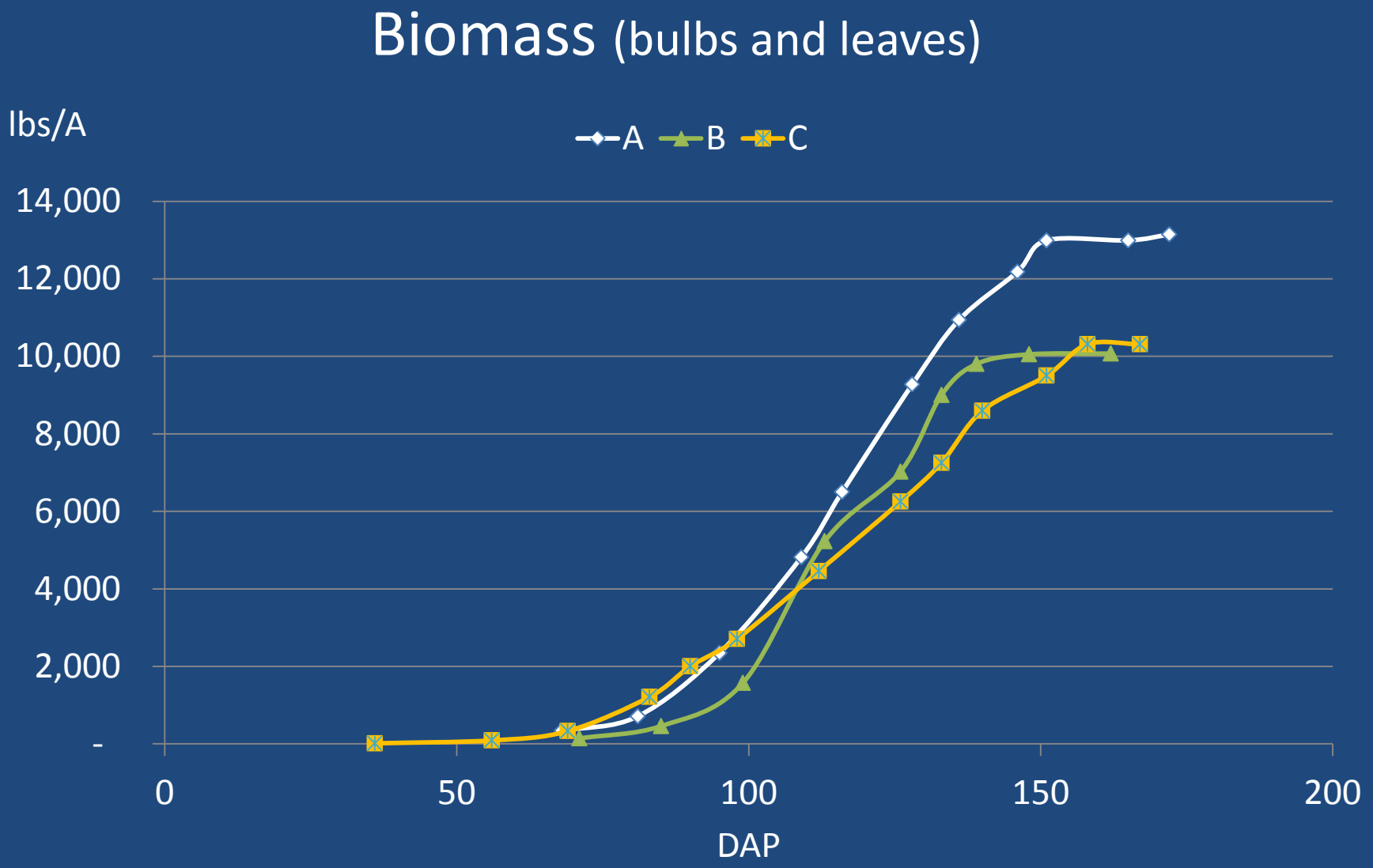




Root Depth

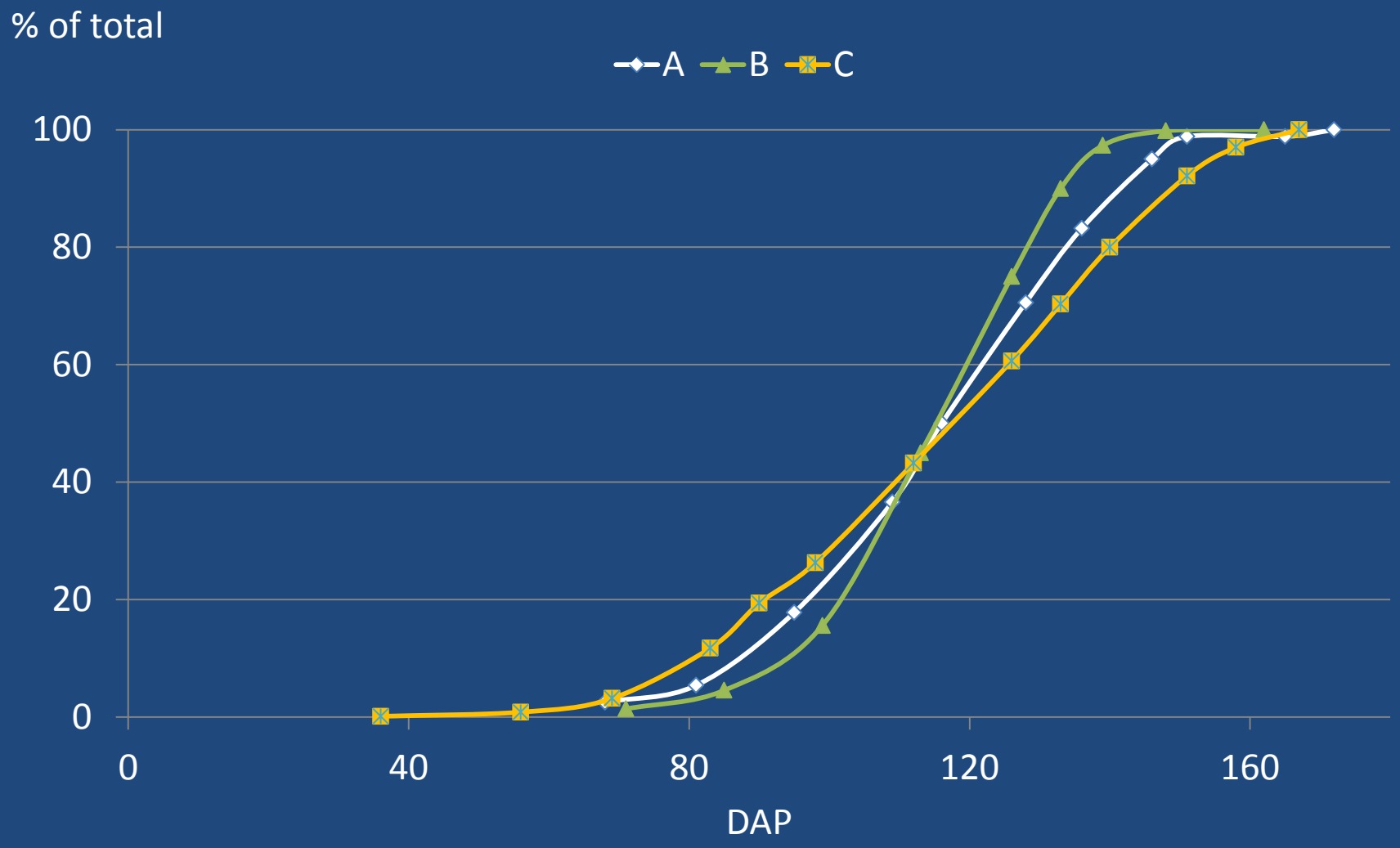
Yield

Results

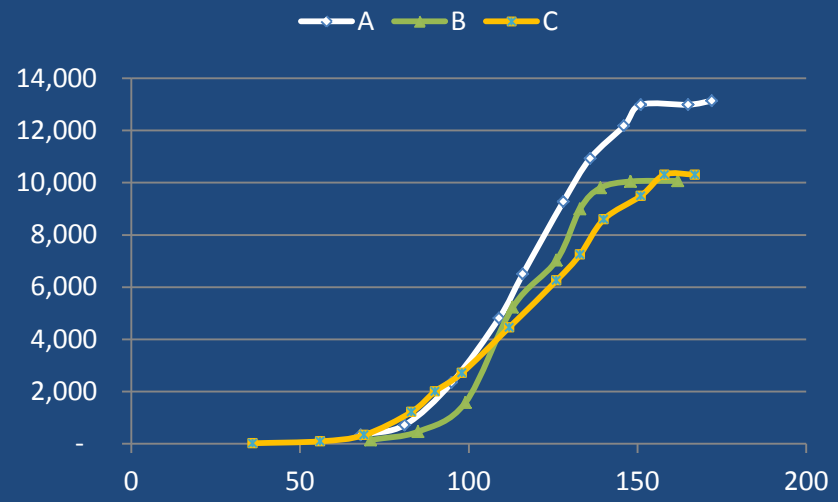


*Average of 4 locations

Biomass



Biomass



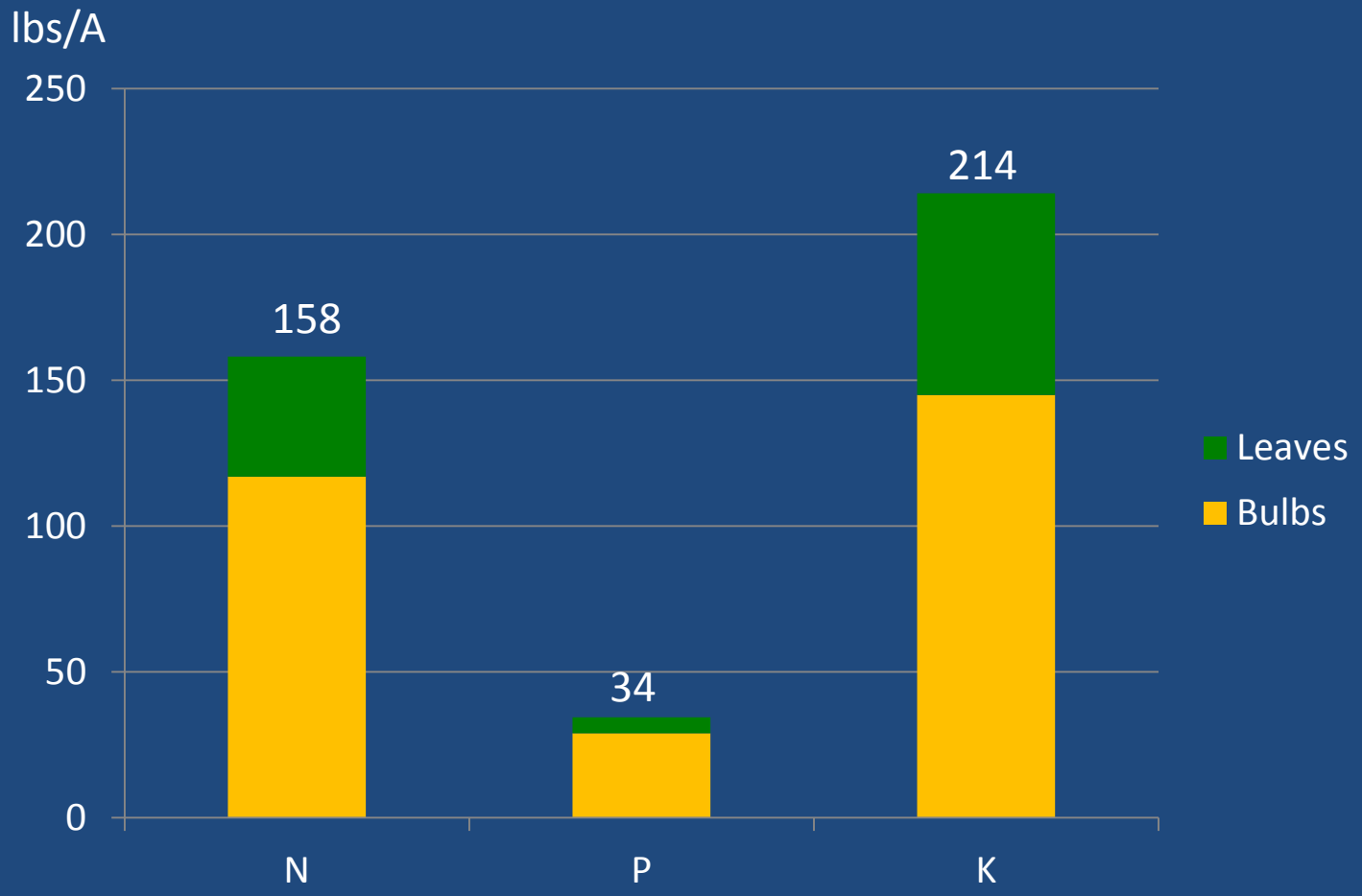
X

Lab Analysis

Lab ID	N (% Total)	P (% Total)	K (% Total)
1	4.65	0.472	5.97
2	4.66	0.497	5.51
3	4.44	0.47	5.33
4	4.49	0.381	4.74
5	3.94	0.336	4.83
6	4.66	0.438	5.48
…	…	…	…

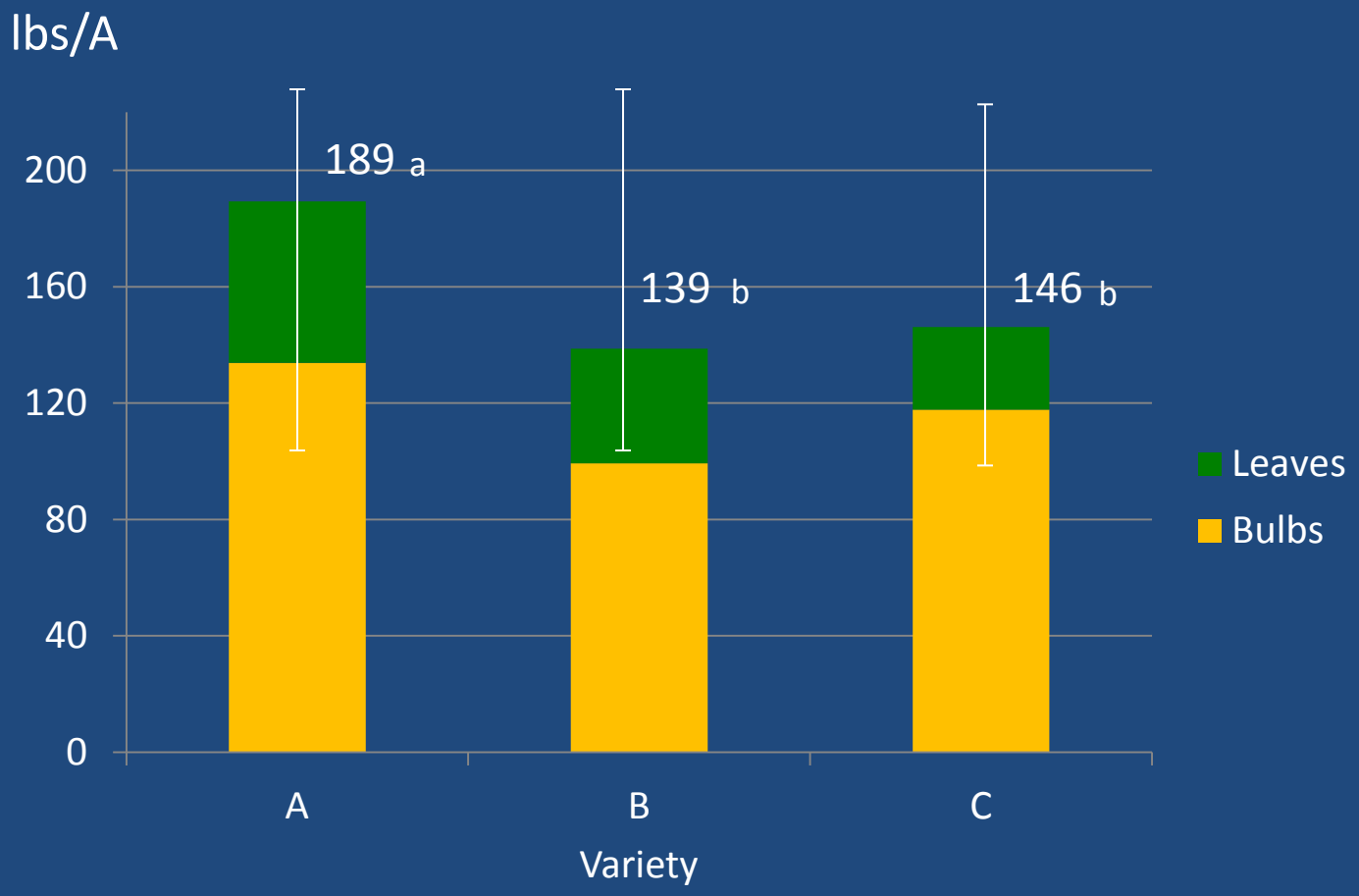
→ lbs of NPK/A

Total Nutrient Uptake



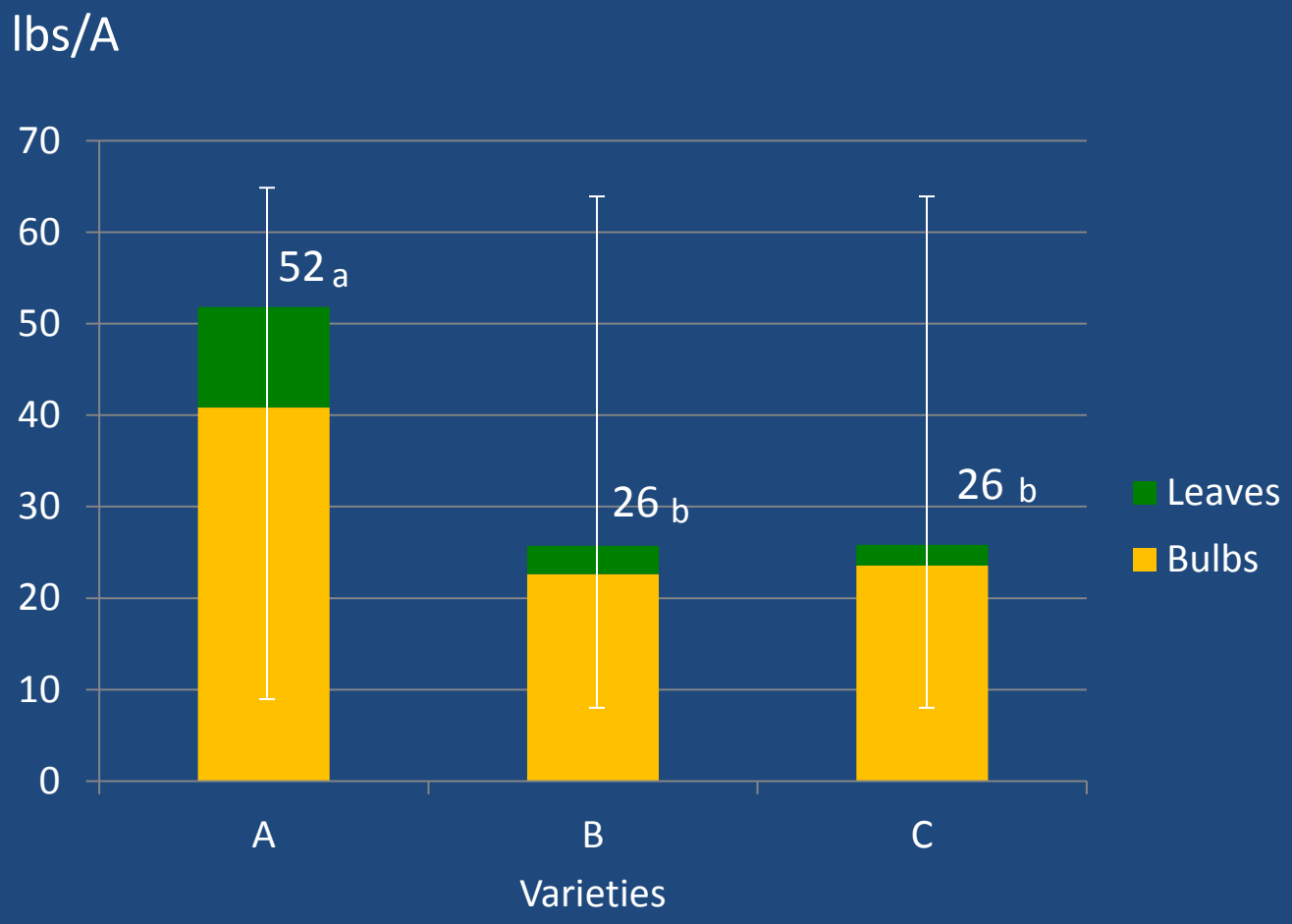
- Average of 3 varieties, 4 sampling locations each

Nitrogen



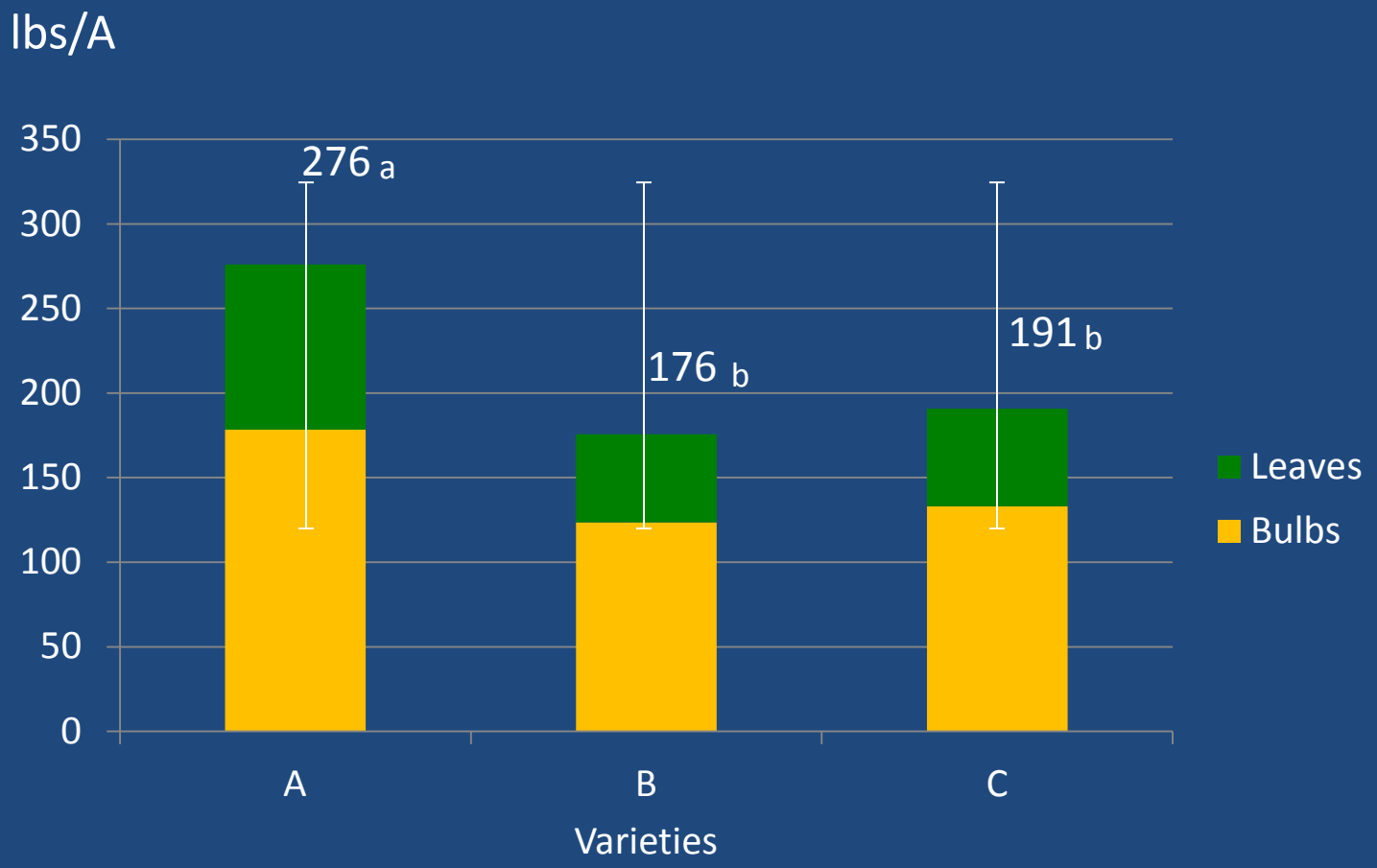
- *Average of 4 locations;*
- *P = 0.0313*
- *Error bars = 2 std. dev. = 95% conf. inter.*

Phosphorus



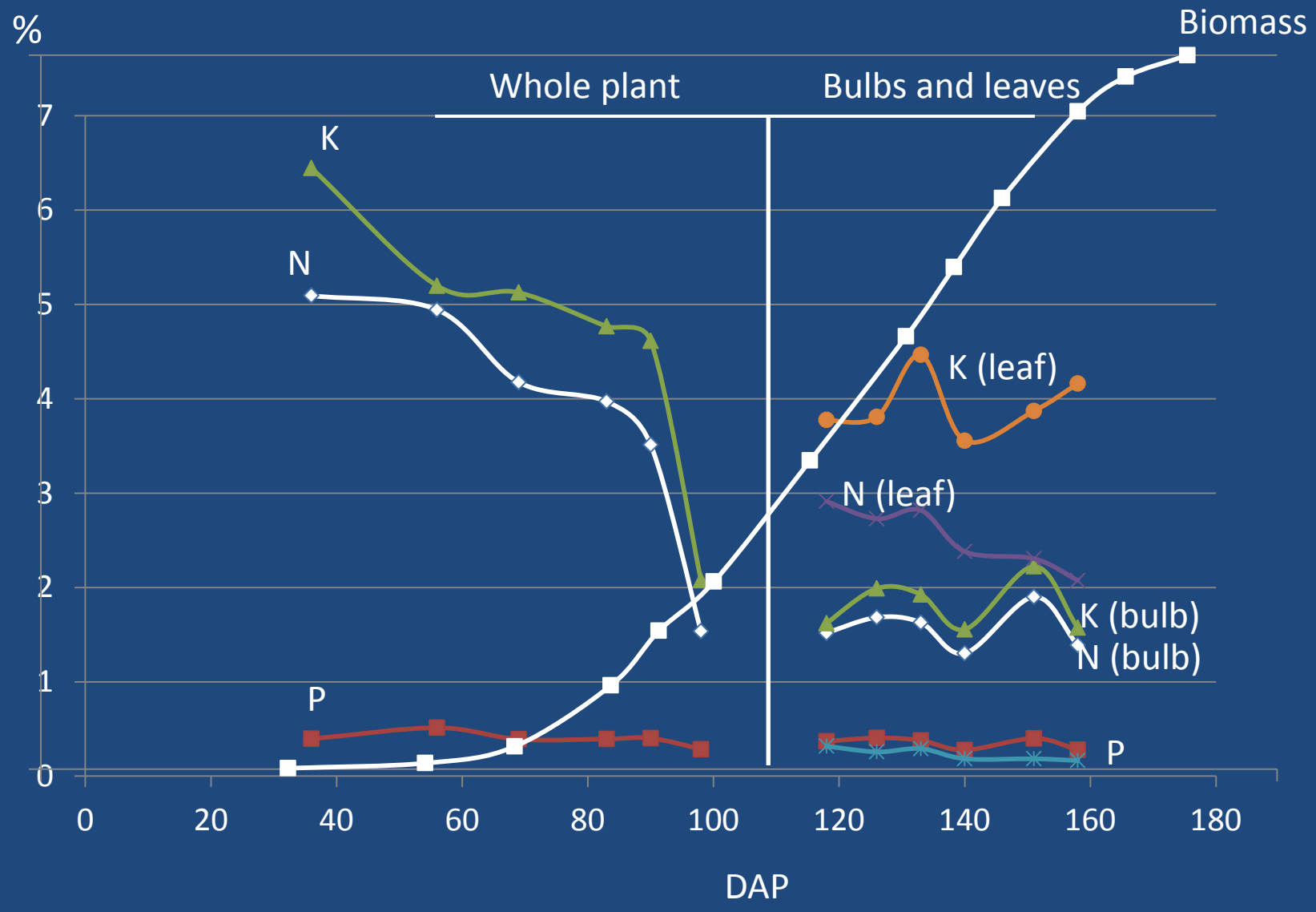
(Average of 4 sampling locations; P<0.001)

Potassium



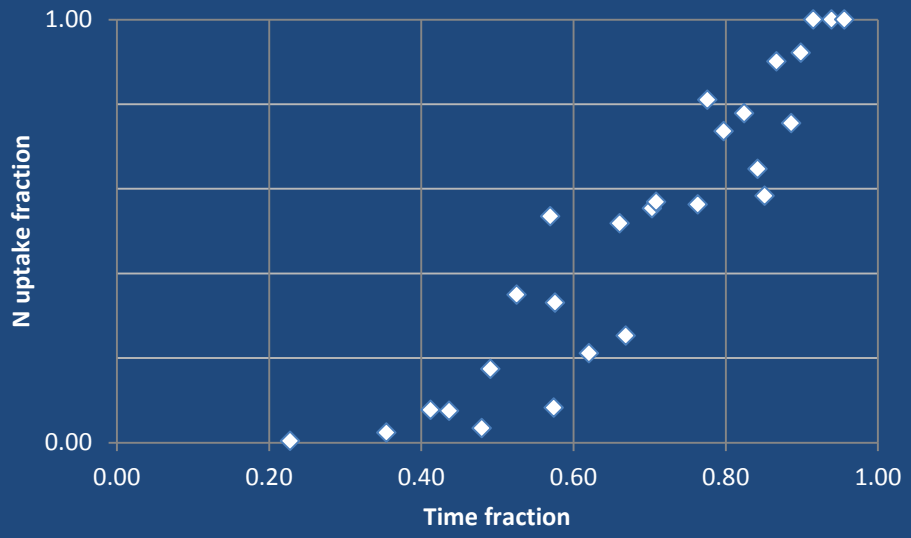
(Average of 4 sampling locations; P=0.001)

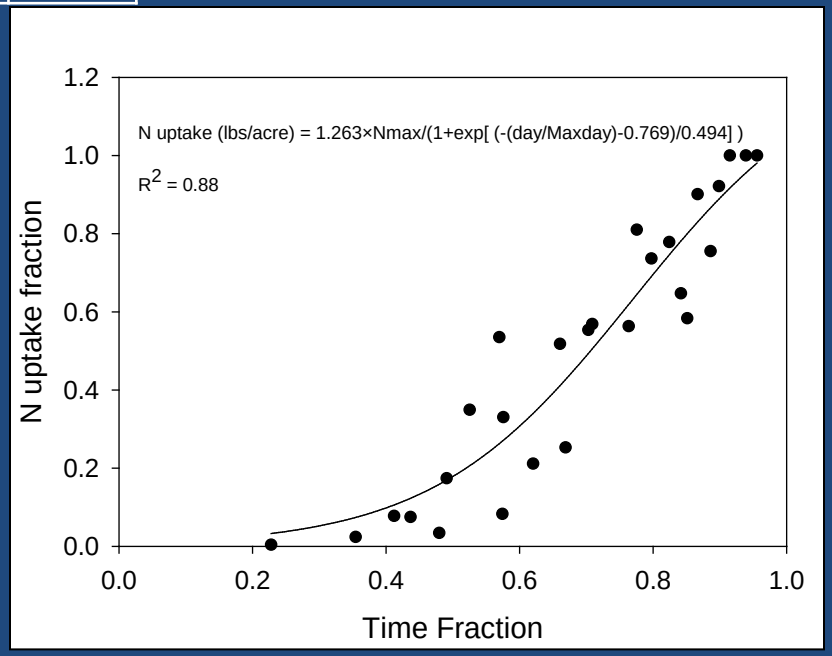
NPK concentration



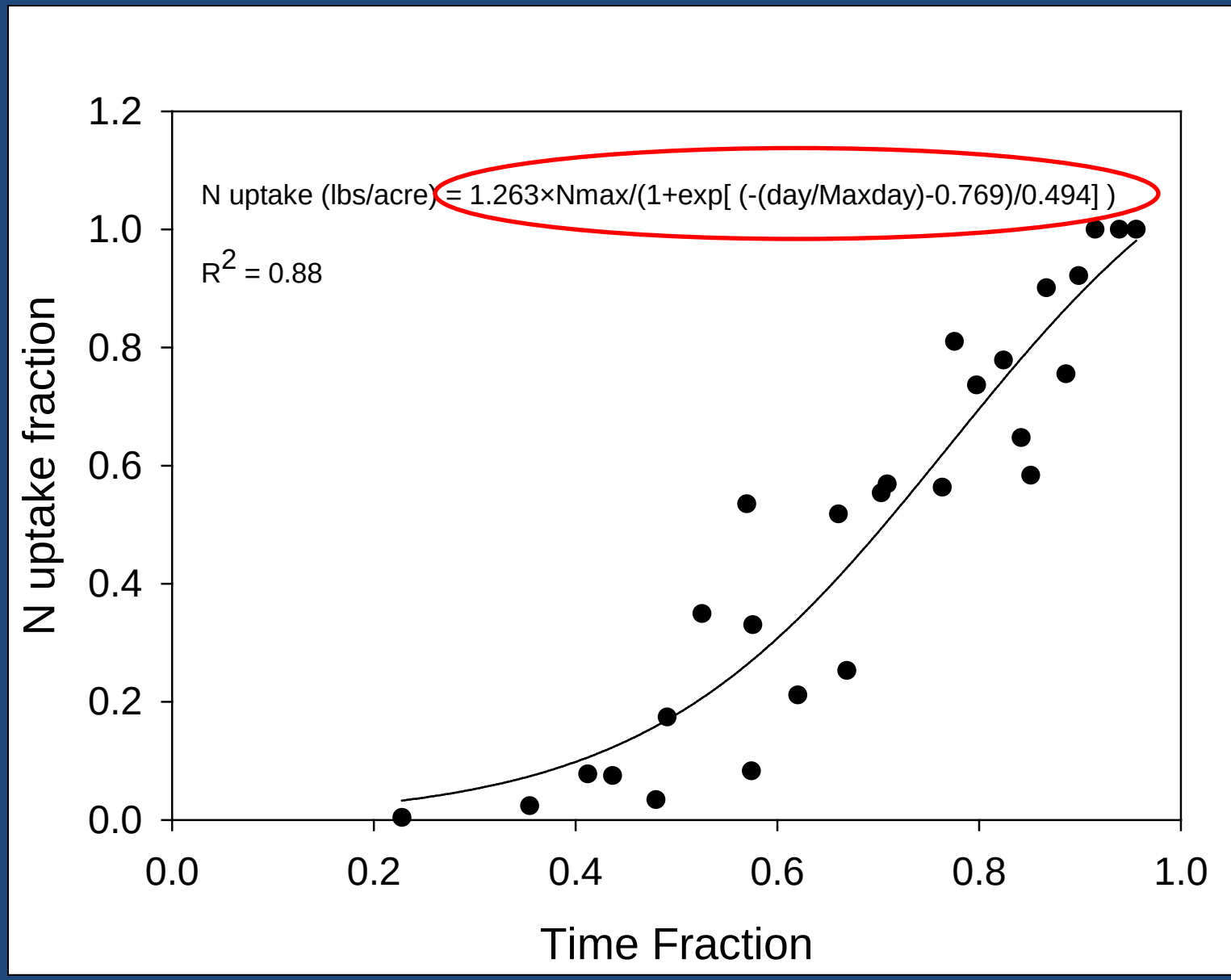
And more data analysis…

DAP	time fraction	Time fraction harvest	N	P	K	fraction N	Fraction P	Fraction K
68	0.41	0.41	14	1	17	0.08	0.03	0.06
81	0.49	0.49	32	3	38	0.17	0.06	0.14
95	0.58	0.58	62	10	80	0.33	0.19	0.29
109	0.66	0.66	97	19	131	0.52	0.36	0.47
116	0.70	0.70	103	21	149	0.55	0.40	0.53
128	0.78	0.78	151	33	213	0.81	0.63	0.76
136	0.82	0.82	145	34	198	0.78	0.66	0.71
143	0.87	0.87	168	41	246	0.90	0.80	0.88
151	0.92	0.92	187	52	279	1.00	1.00	1.00

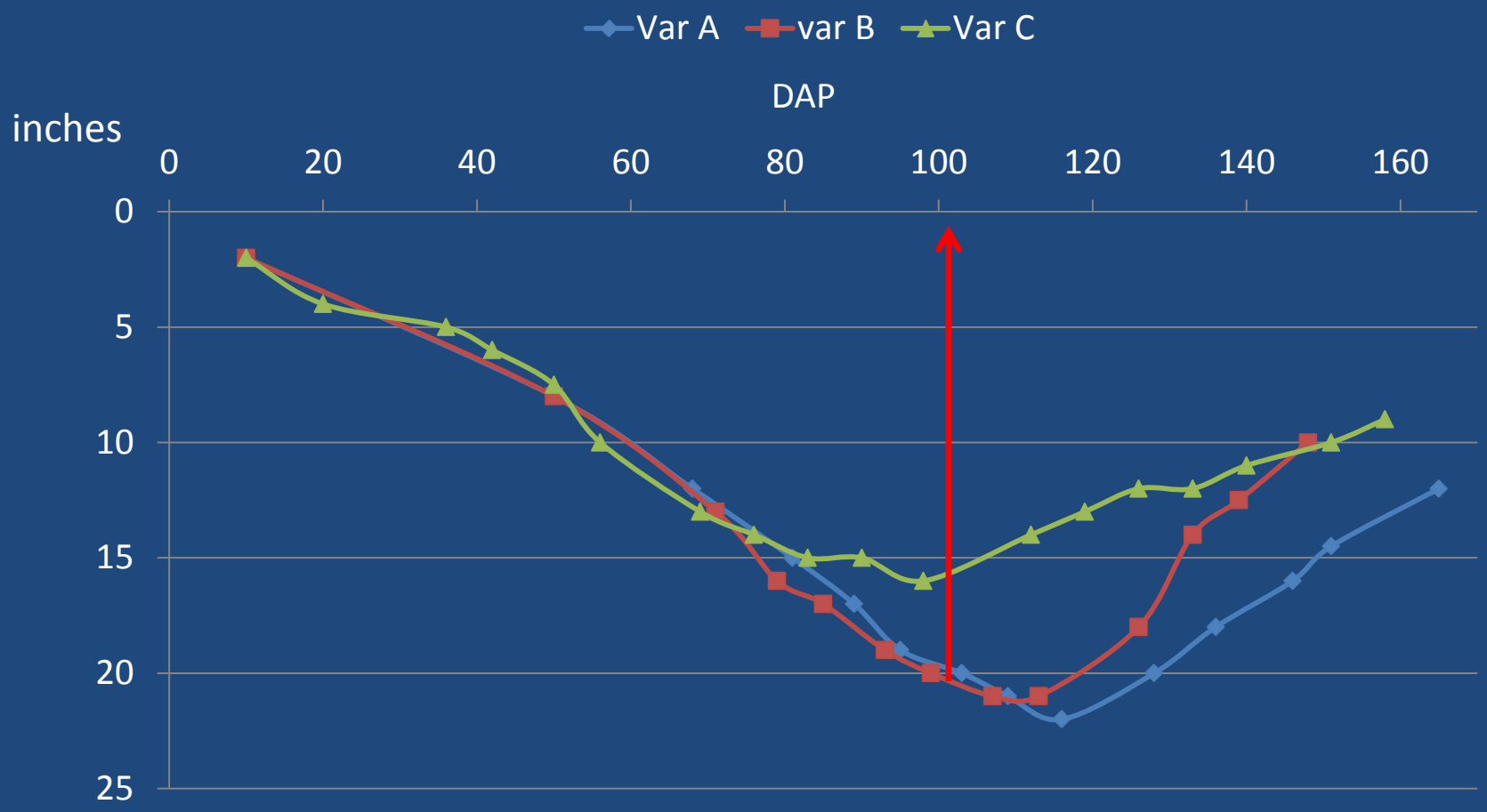




Results – N Uptake Curve

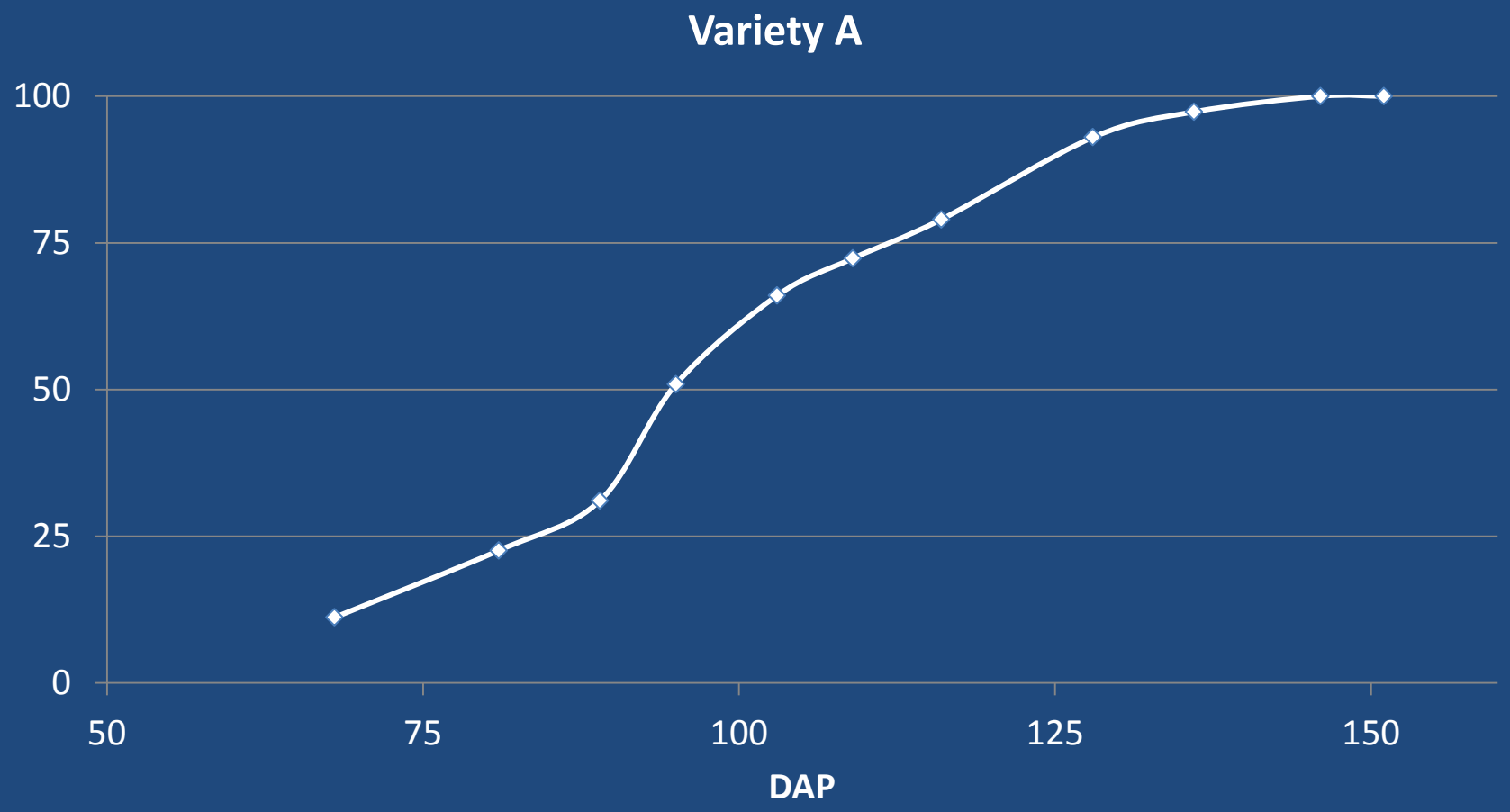


Root Depth

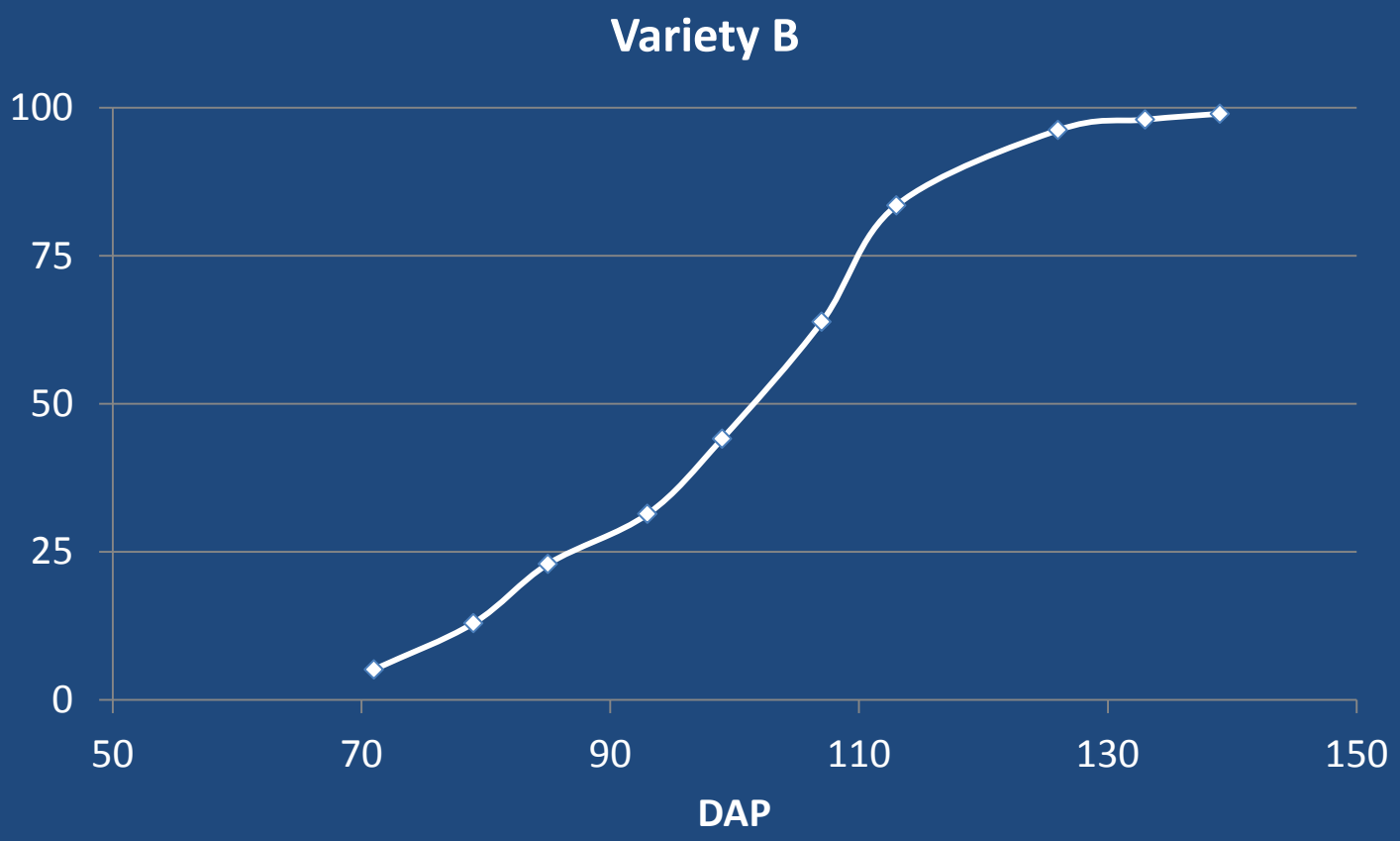

Var A
var B
Var C
DAP
inches
0
20
40
60
80
100
120
140
160
0
5
10
15
20
25

Results -
Canopy Cover (%)

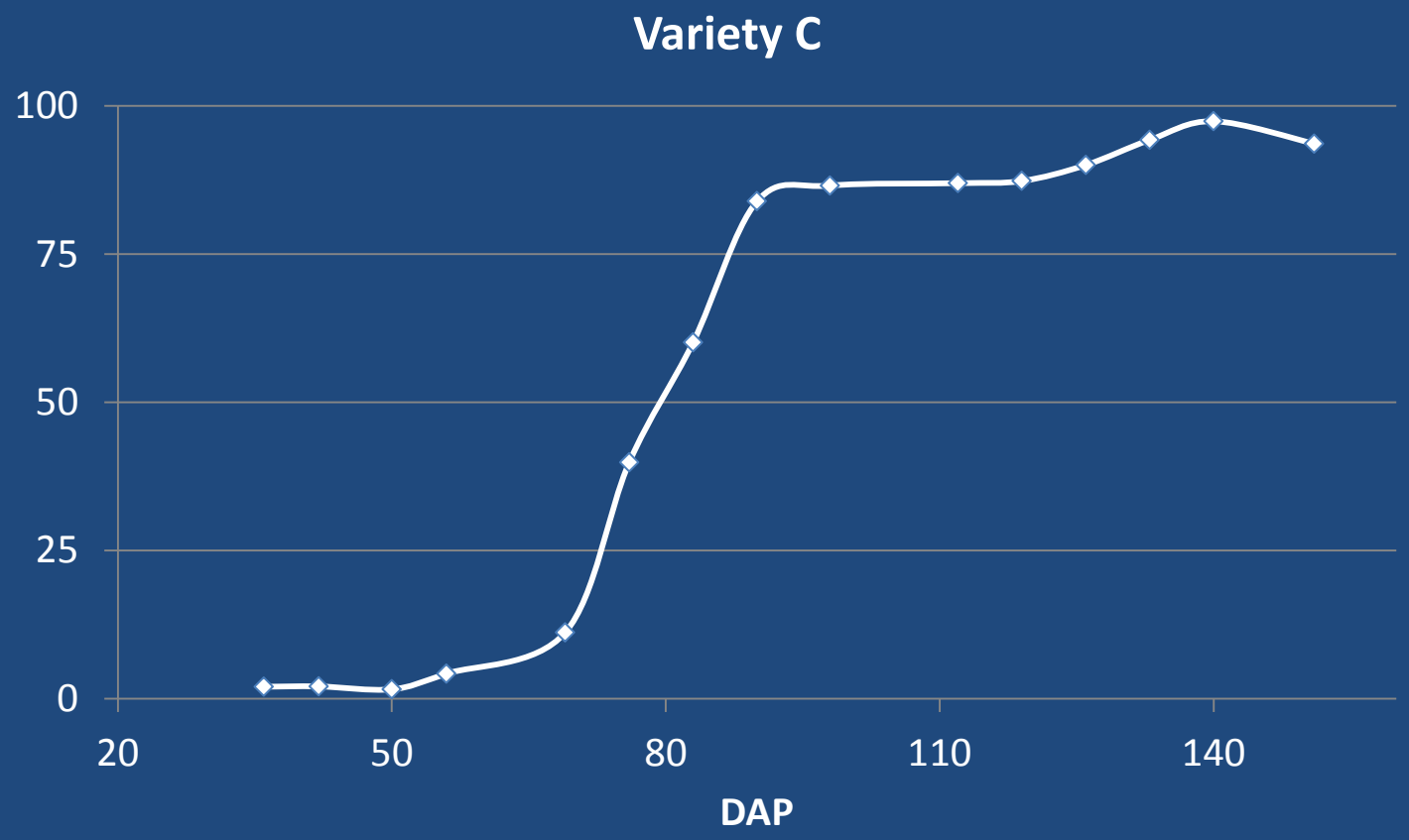
Canopy Cover (%)



Canopy Cover (%)

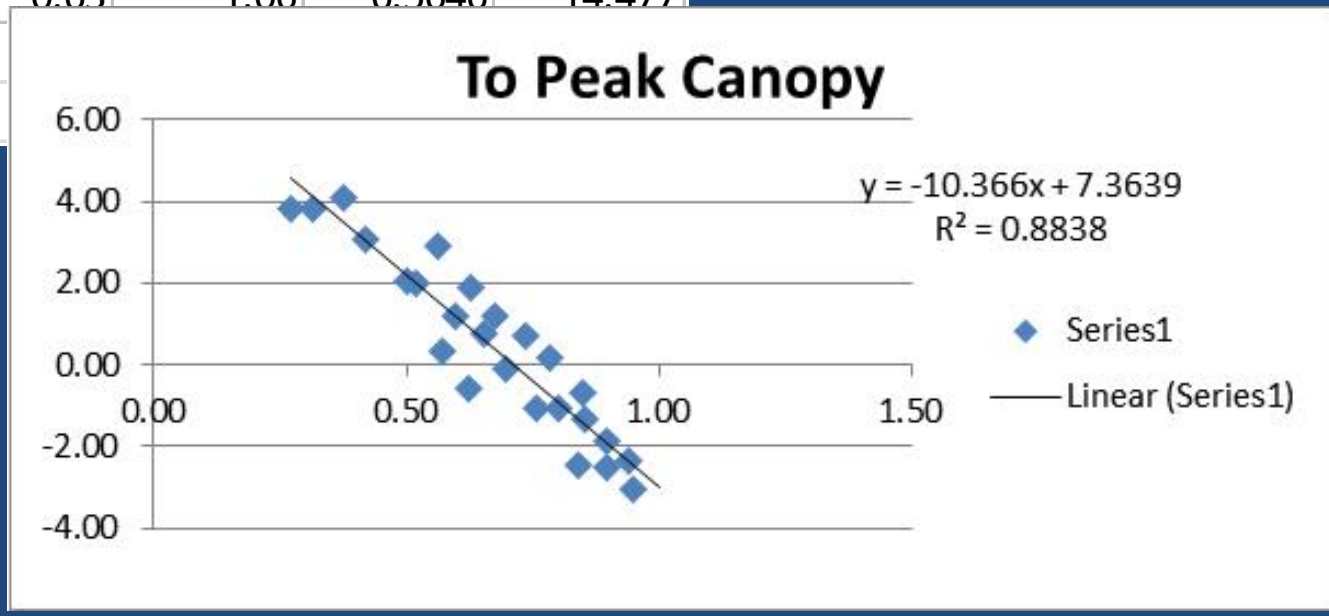


Canopy Cover (%)

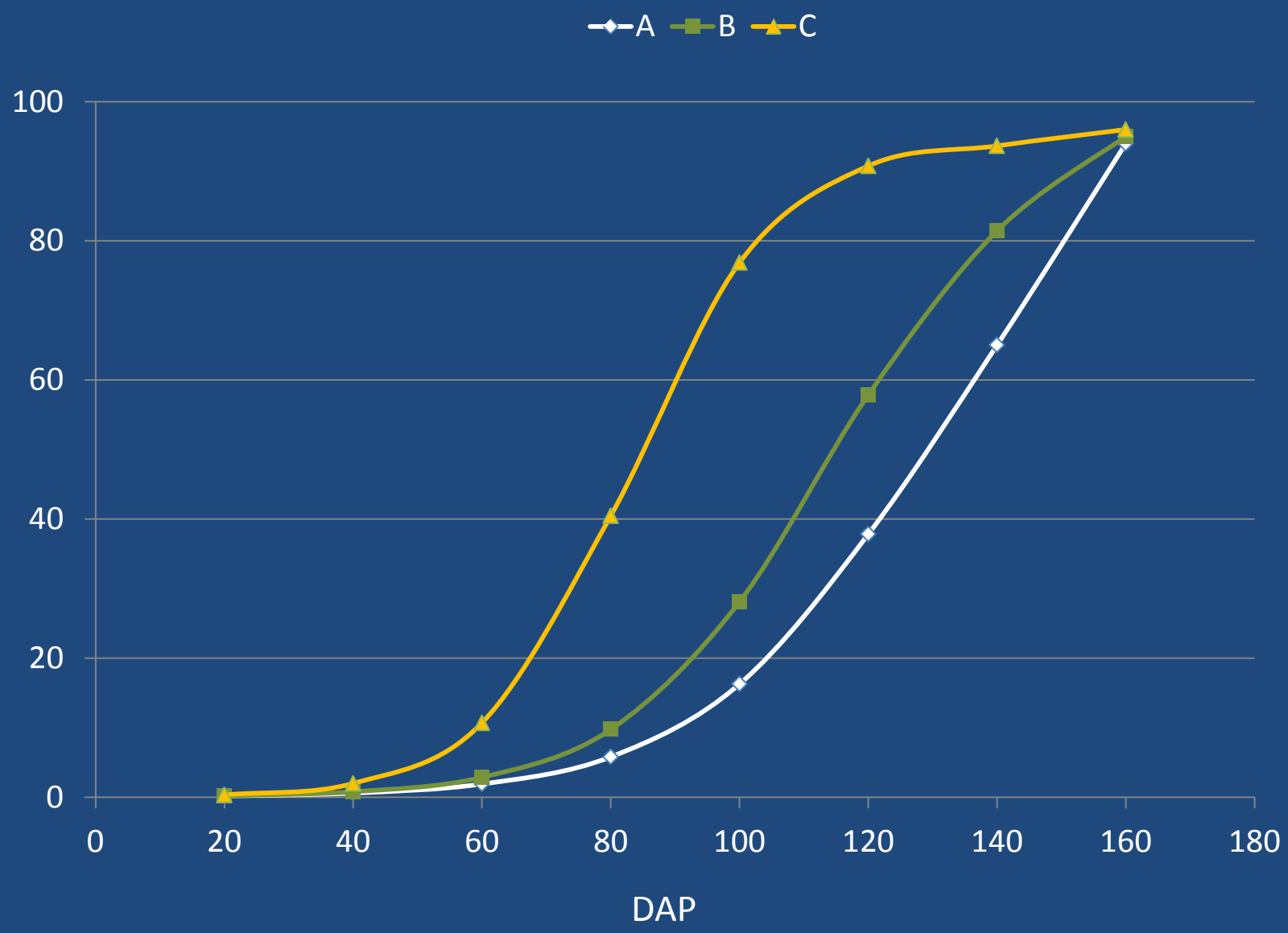


Predicted Canopy =
Max Canopy/(1+EXP(coef_A+coef_B*Ni*fc))

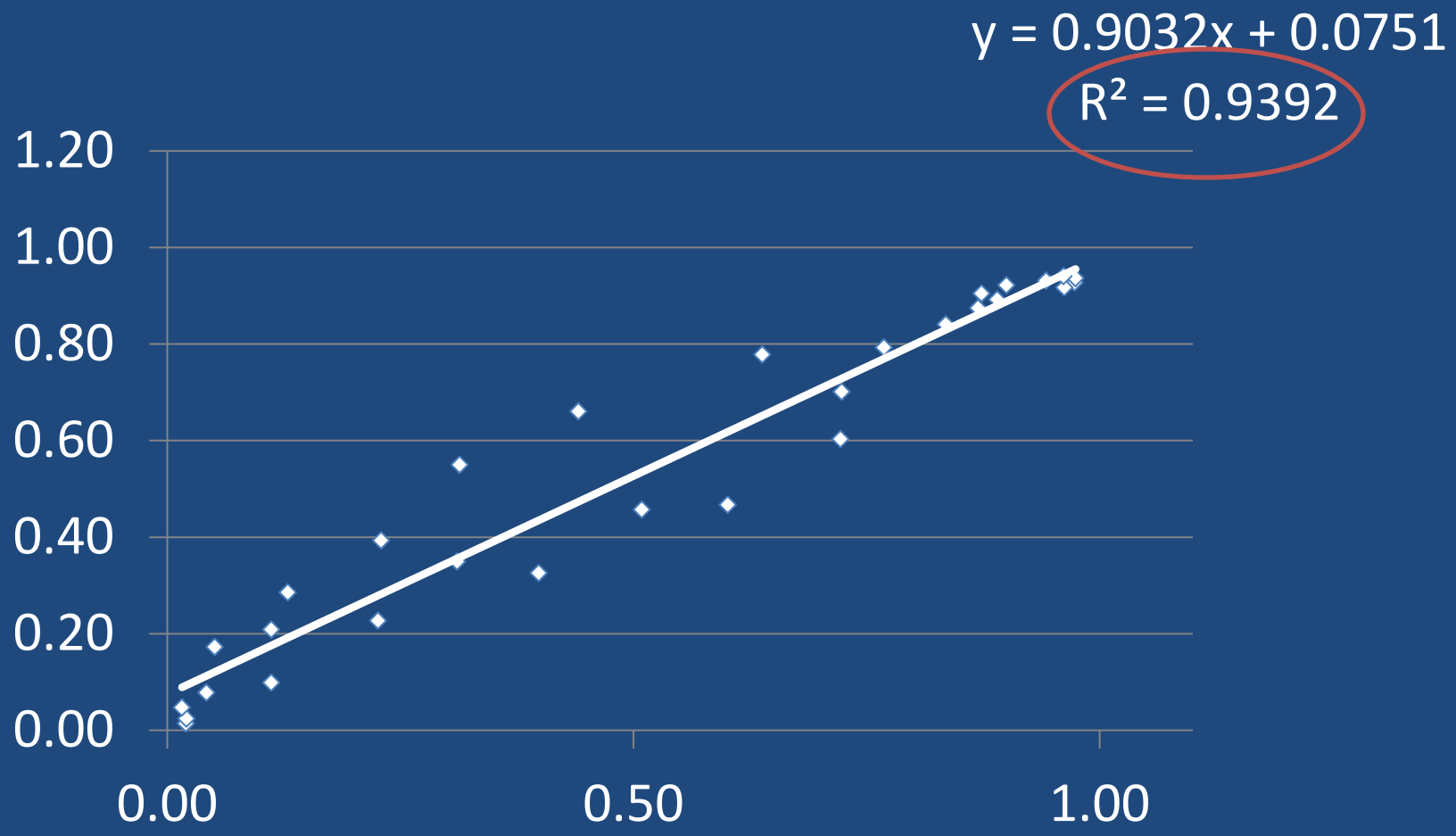
Ni	ln(Gx/Gi)	Ni Calc	ln(Gx/Gi)-1 calc	Canopy coef A	Canopy coef B
0.40	2.04	0.40	2.04	6.5646	-14.477
0.47	1.20	0.47	1.20	6.5646	-14.477
0.52	0.76	0.52	0.76	6.5646	-14.477
0.55	-0.09	0.55	-0.09	6.5646	-14.477
0.60	-1.06	0.60	-1.06	6.5646	-14.477
0.63	-1.06	0.63	-1.06	6.5646	-14.477
0.67	-1.32				
0.74	-2.37				



Predicted Canopy (%)



Canopy, Measured vs. Predicted



Summary

- Data created with this study will allow more accurate decisions of fertilizer and water management
- Data shows the importance of developing local information – differences with Pacific Northwest
- Onion growth (biomass, nutrient uptake, root and canopy cover) are better understood and can be more accurately predicted based on DAP

Summary

- Total N, P and K uptake amounts and patterns
- Right Rate and Right Time of fertilizers
- Next: validate the information on test plots.

Thank you:

- John Calandri
- Jorge Nuniz
- Mark Proctor
- Michael Cahn