



Nutrient Management In Brassica Crops

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Nitrogen Management of Leafy Vegetables

- **Nitrogen management of vegetables in the coastal production districts is under greater scrutiny**
- **Growers will need to report N usage to the Central Coast Regional Water Quality Control Board in 2014**

Nitrogen Management of Leafy Vegetables

- **As a result, growers are looking for tools to improve nitrogen use efficiency**

Nitrogen Management of Leafy Vegetables

- **An important tool in nitrogen management is to account for residual N mineralized from prior crop residues**

Nitrogen Management of Leafy Vegetables

- **Another way of improving nitrogen use efficiency is to capture nitrate that may have moved to deeper in the soil profile and bring it back to the surface for another opportunity to use it**

Nitrogen Management of Leafy Vegetables

- **Crops like sugar beets and small grains, when they were viable crops in the Salinas Valley, were capable of retrieving nitrogen from deeper in the soil profile**
- **Cover crops can do this but we are limited in their use**

Nitrogen Management of Leafy Vegetables

- **In recent studies funded by the Fertilizer Research and Education Program (CDFR), we observed that cole crops can scavenge nitrate**

Nitrogen Uptake by Broccoli, Cauliflower and Cabbage



Nitrogen Dynamics in Cole Crops – Summer Production

Crop	Dry Biomass Lbs/A	Percent Nitrogen	Percent Potassium	Potassium Uptake Lbs/A	Phosphorus Uptake Lbs/A
Broccoli	8,585	4.0	4.2	360	44
Cauliflower	6,930	4.1	4.3	299	45
Cabbage	11,564	3.0	3.2	361	42

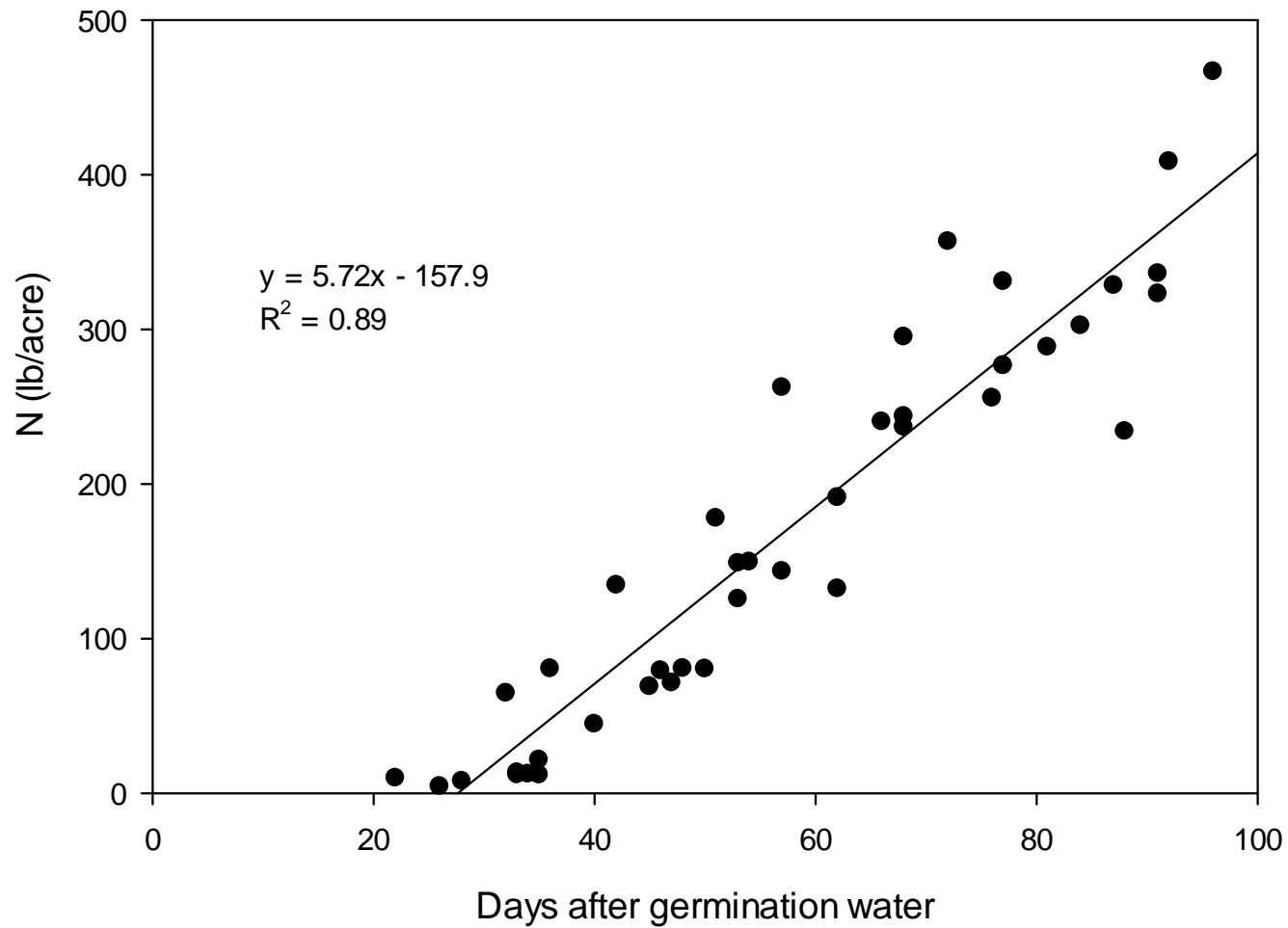
Nitrogen Dynamics in Cole Crops – Summer Production

Crop	Harvest Product N/A	Leaves N/A	Stalks N/A	Roots N/A	Residue N/A
Broccoli	99	198	41	11	238
Cauliflower	61	204	20	10	224
Cabbage	188	164	---	9	163

Nitrogen Dynamics in Cole Crops – Summer Production

Crop	Fertilizer applied	Crop Uptake	Scavenged from soil
Broccoli	181	337	155
Cauliflower	260	285	21
Cabbage	215	337	97

Nitrogen Uptake Curve Summer Broccoli



Nitrogen Dynamics in Cole Crops – Winter Production

Crop	Dry Biomass	Percent Nitrogen	Percent Potassium	Potassium Uptake	Phosphorus Uptake
Broccoli	5,539	4.5	3.3	194	32
Cauliflower	6,490	4.2	3.7	236	36

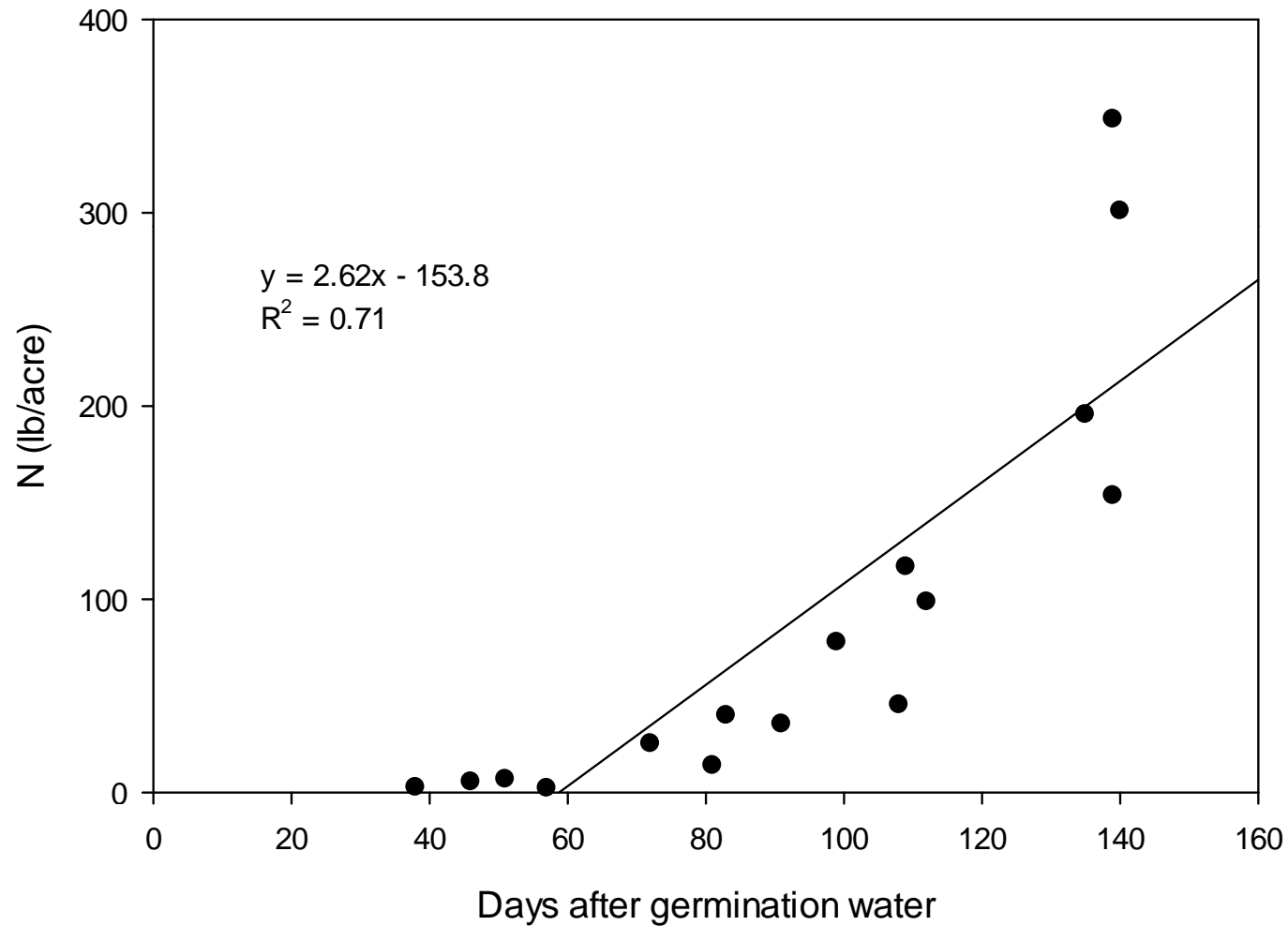
Nitrogen Dynamics in Cole Crops – Winter Production

Crop	Harvest Product N/A	Leaves N/A	Stalks N/A	Roots N/A	Residue N/A
Broccoli	94	128	29	8	156
Cauliflower	70	160	14	9	175

Nitrogen Dynamics in Cole Crops – Winter Production

Crop	Fertilizer applied N/A	Crop Uptake N/A	Scavenged from soil N/A
Broccoli	272	249	23+
Cauliflower	351	273	78+

Nitrogen Uptake Curve Winter Broccoli

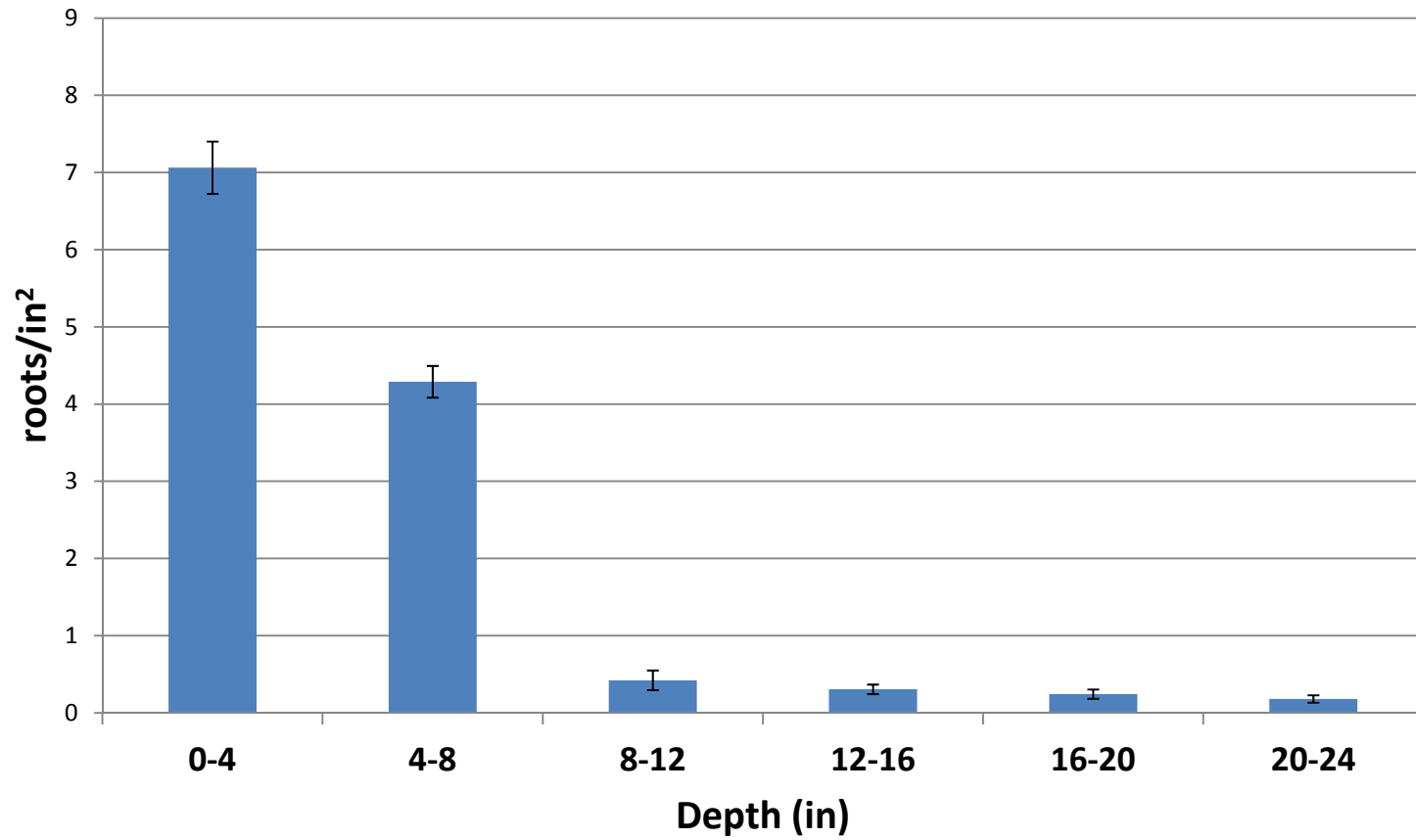


Nitrogen Uptake by Broccoli, Cauliflower and Cabbage

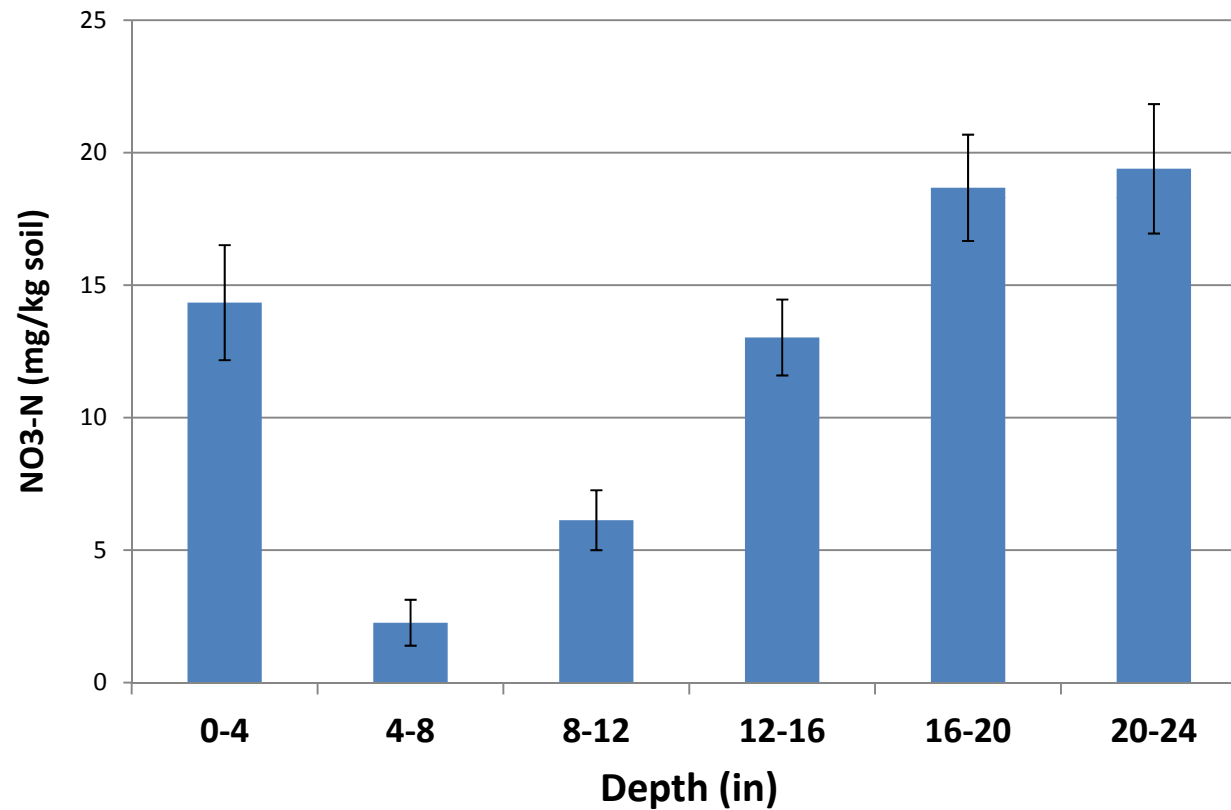
- **Where is the extra nitrogen coming from in the summer-grown broccoli?**
- **Is broccoli acting like a cover crop in that it is bringing up nitrate from deeper in the root zone?**

Rooting Depth and Nitrate at the End of the Growing Season

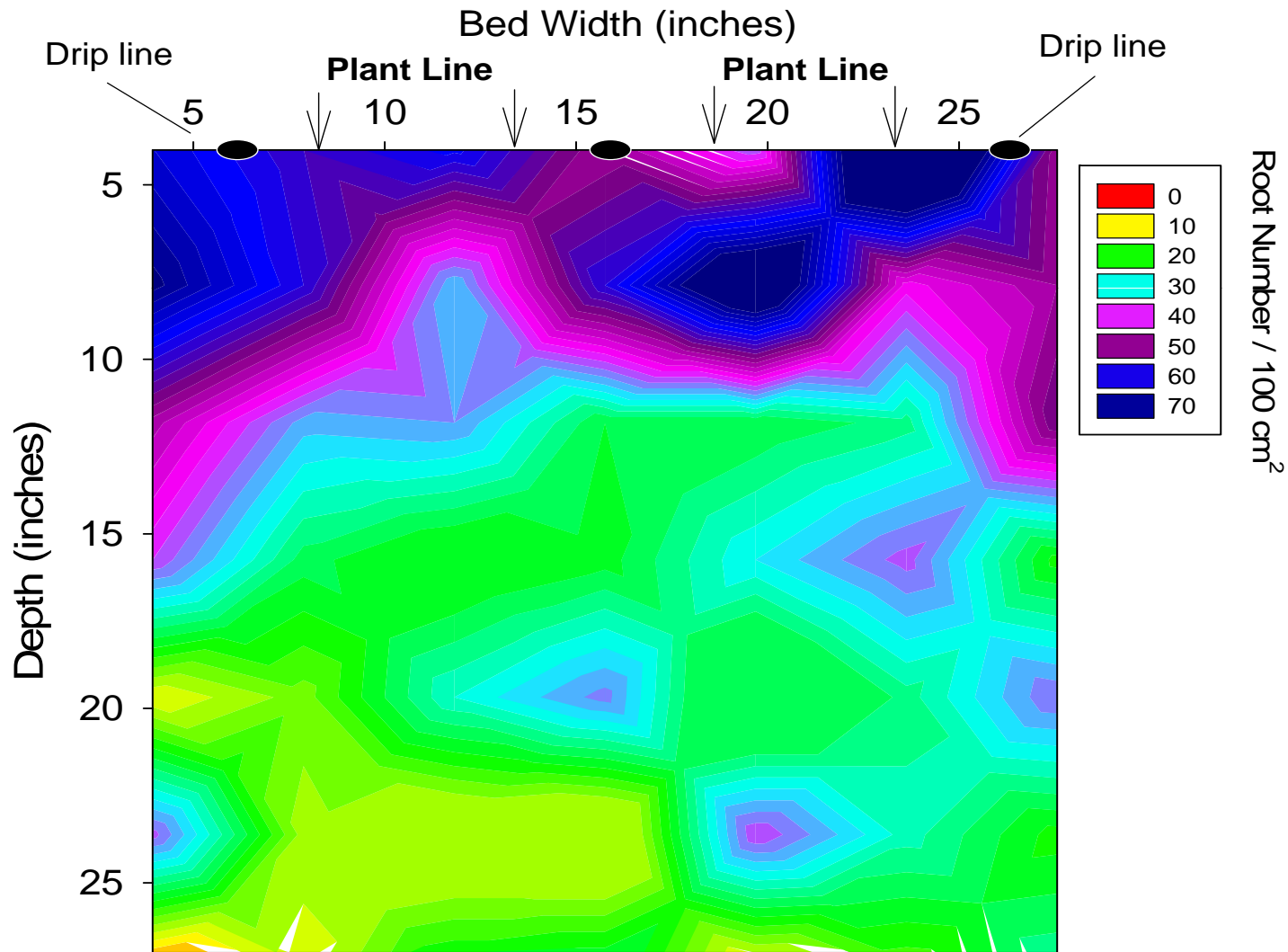
Spinach Root Distribution



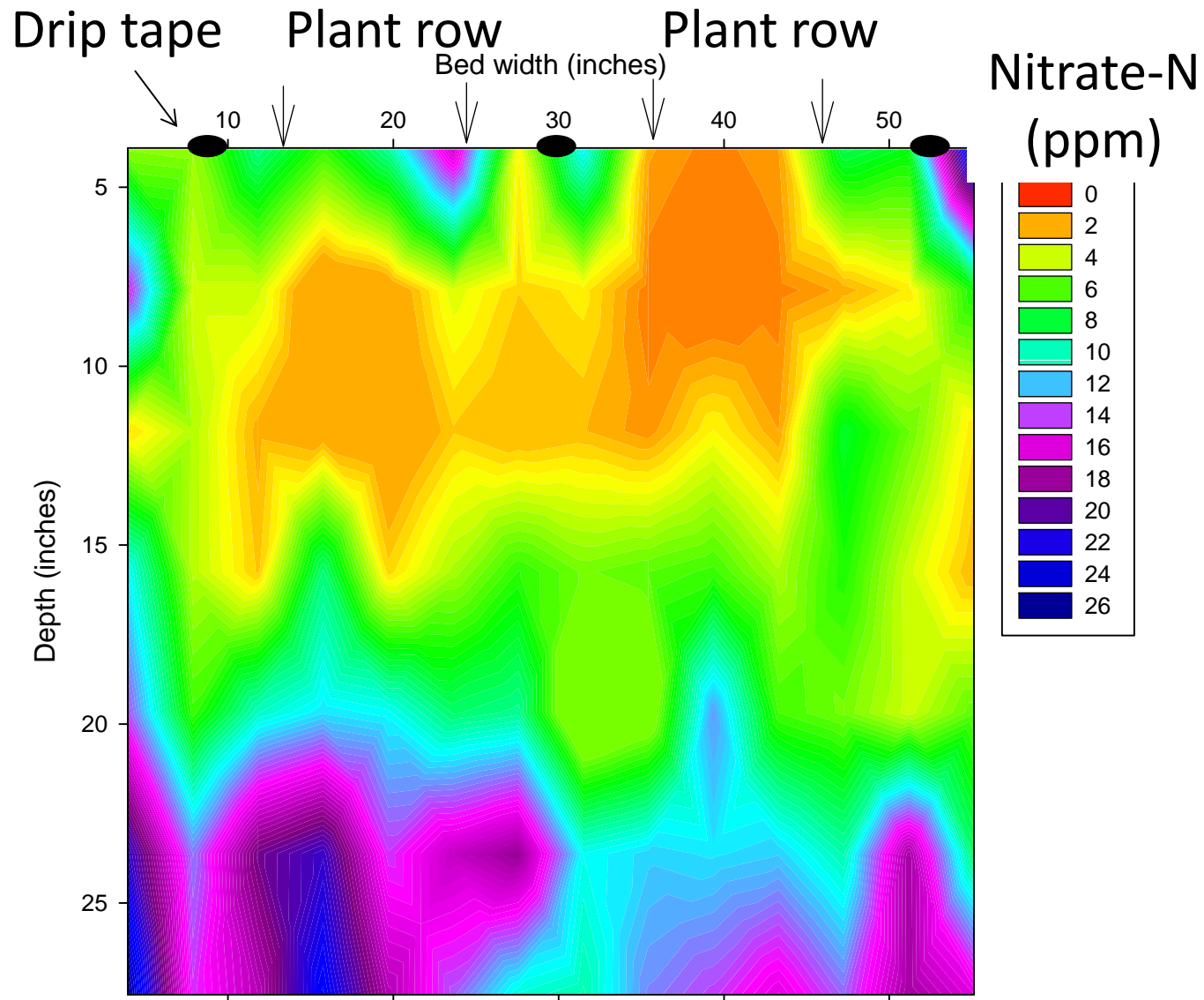
Nitrate Distribution in Spinach Beds at Harvest



Root Density of Lettuce at Various Soil Depths



Soil Nitrate Distribution in Lettuce



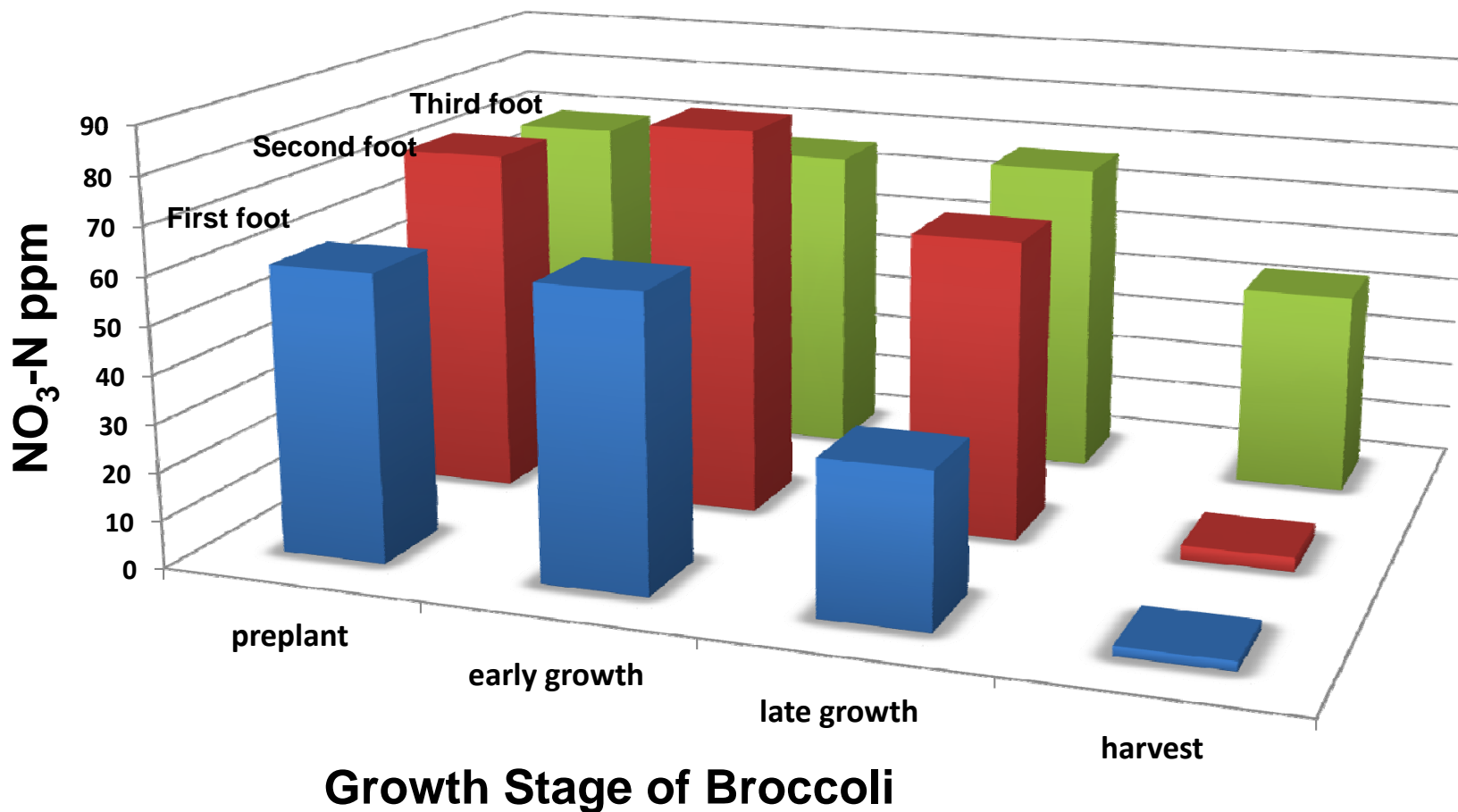
End of Crop Nitrate Dynamics

- **Nitrate can accumulate at the bottom edge of the root zone of lettuce and spinach**
- **Nitrogen from crop residues is also disced into the soil, enriching the upper soil layers with nitrate**

Measurements of nitrate in soil at various depths in the root zone following a prior crop and over the crop cycle of broccoli

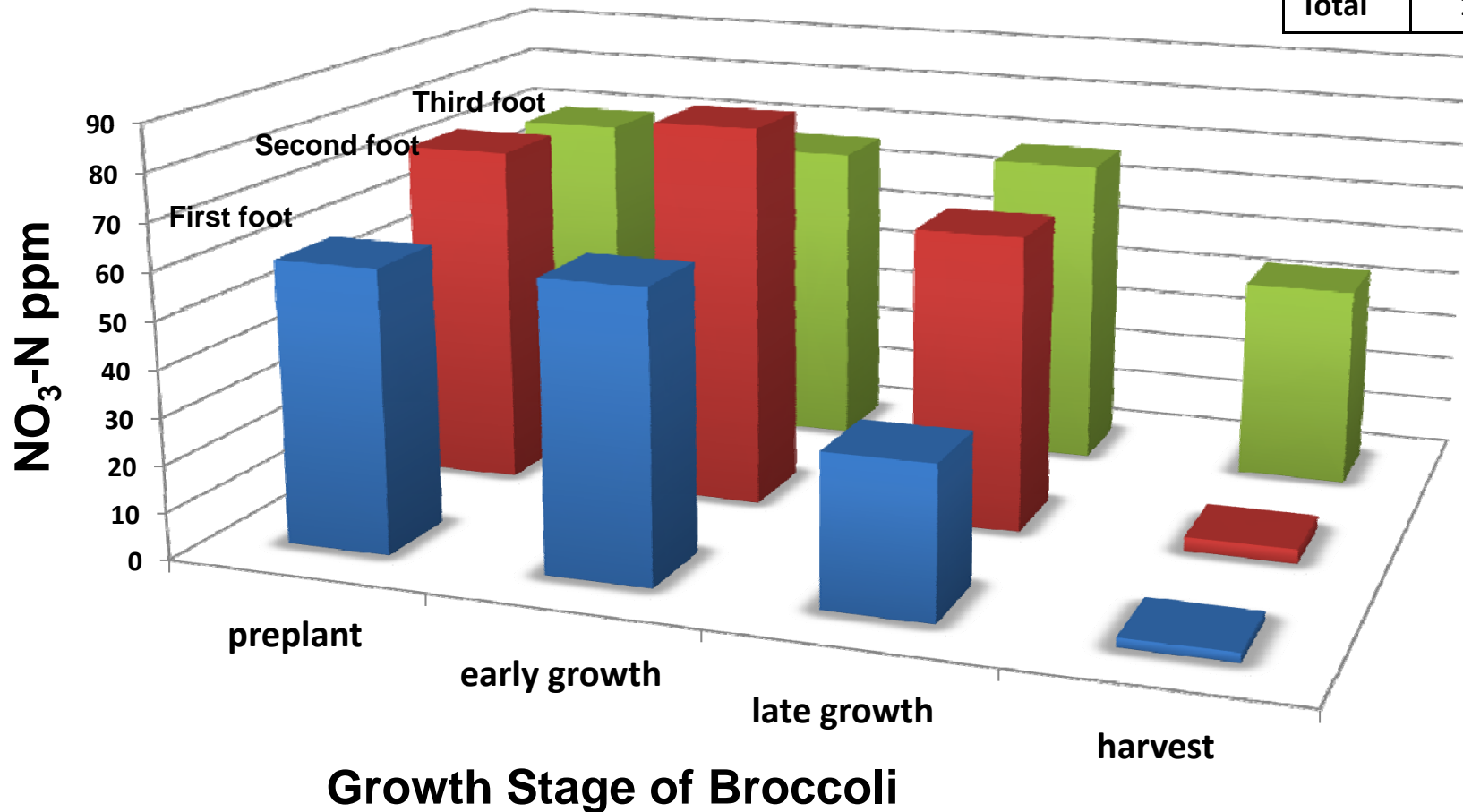
Nitrogen in the Top Three Feet of Soil over the Broccoli Crop Cycle

One Field

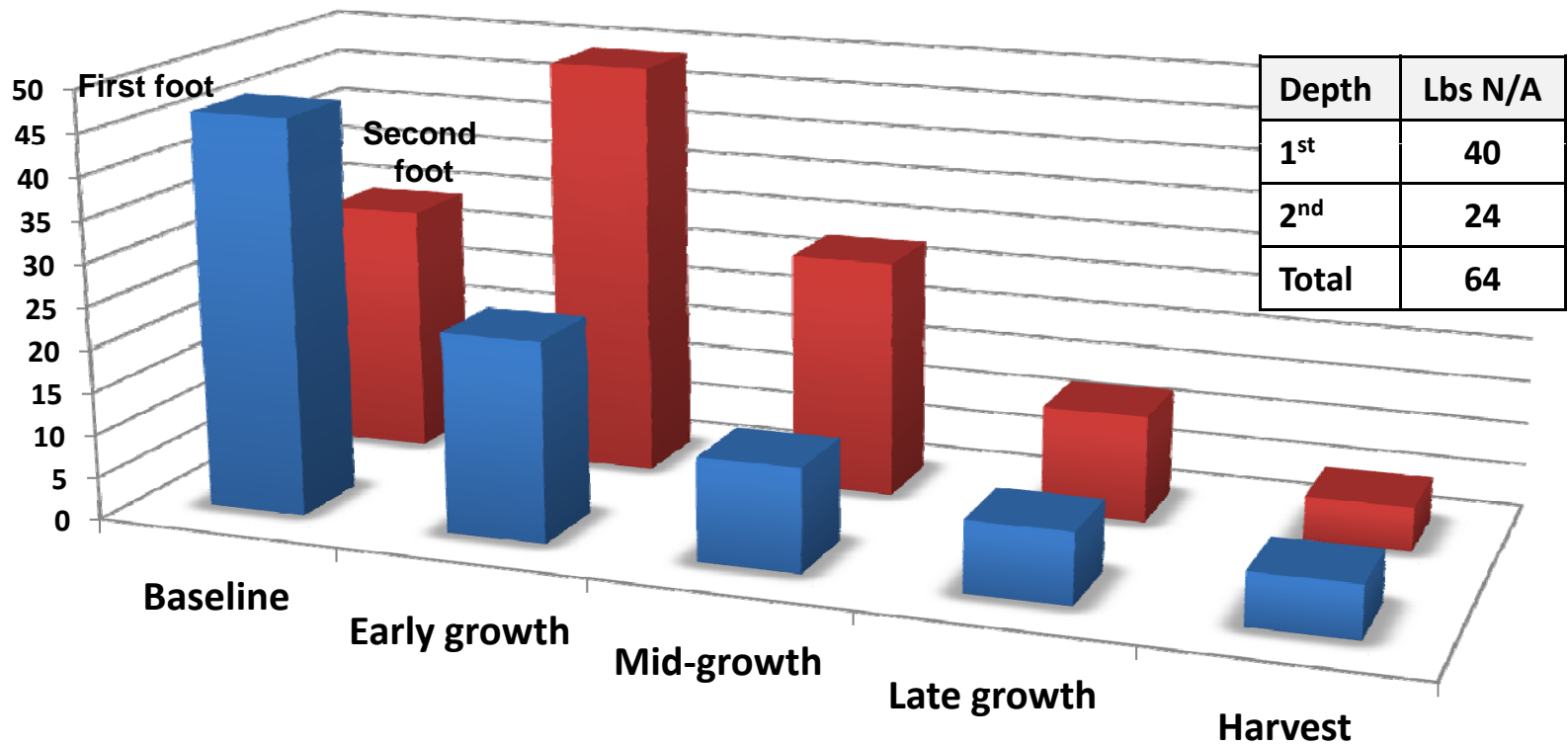


Residual Soil Nitrogen Utilized by the Broccoli Crop One Field

Depth	Lbs N/A
1 st	58
2 nd	70
3 rd	26
Total	154

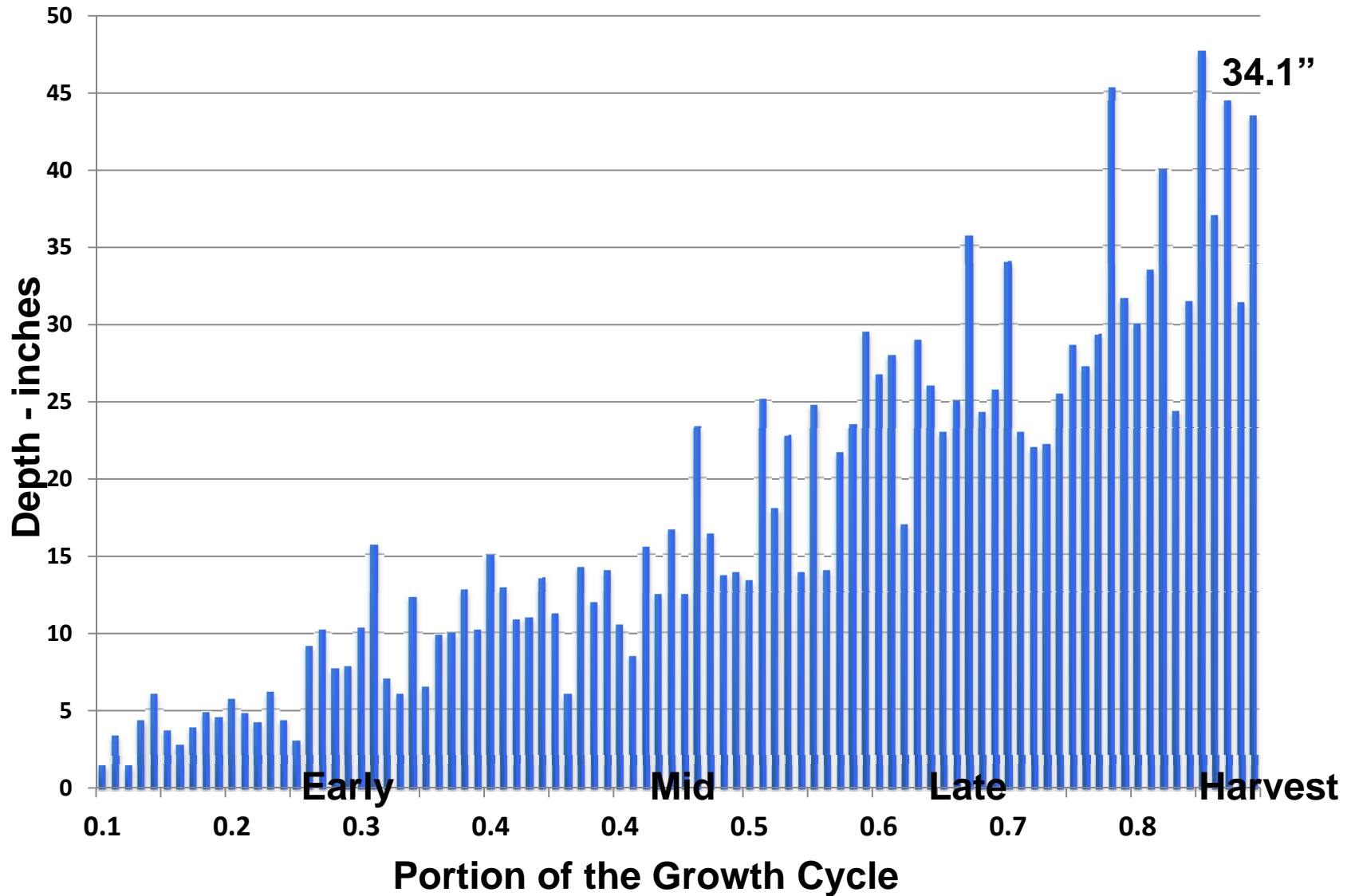


Evaluation of Nitrate in the 1st & 2nd Foot of Soil (5 fields)

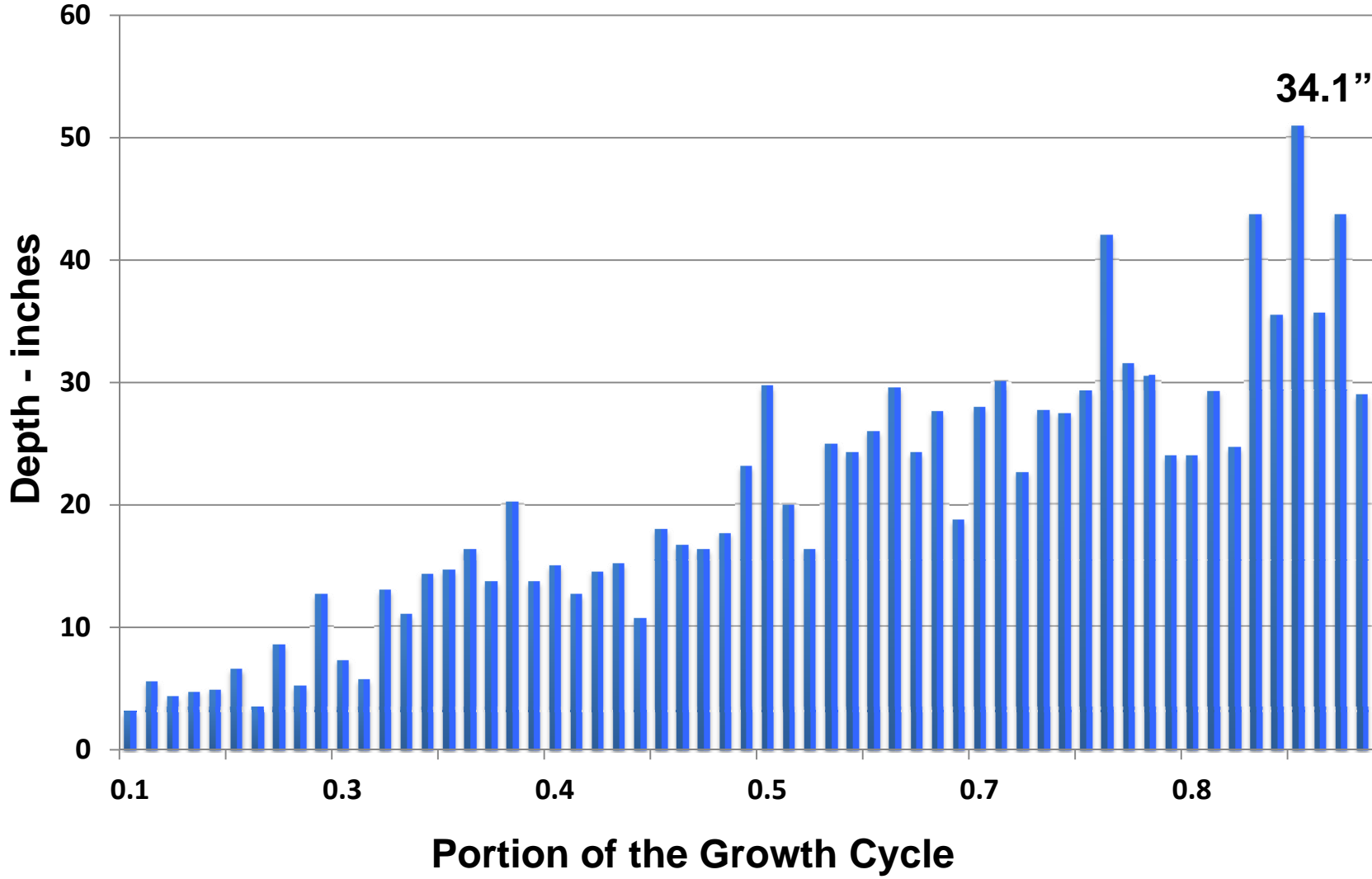


Growth Stage of Broccoli

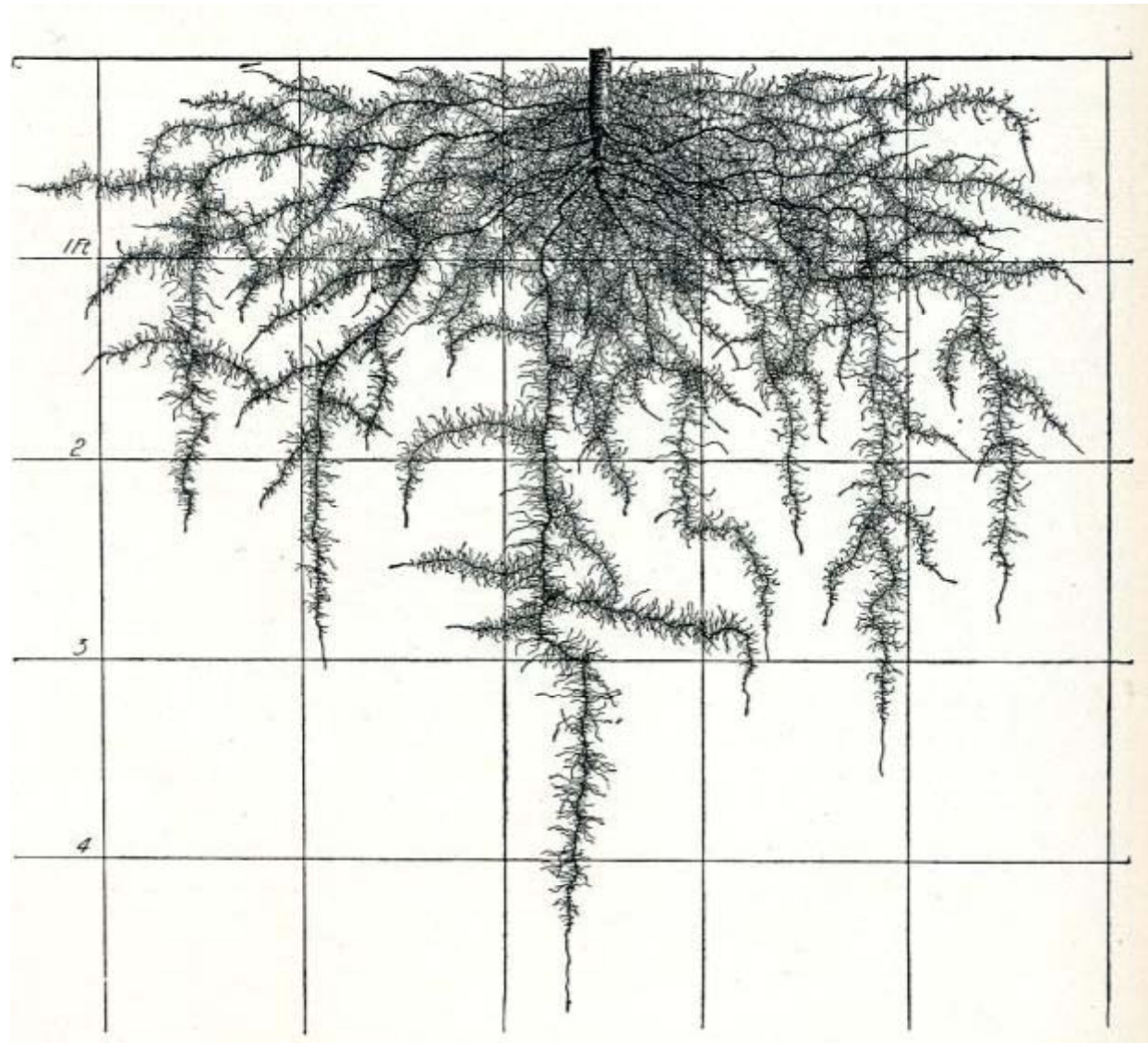
Broccoli Rooting Depth



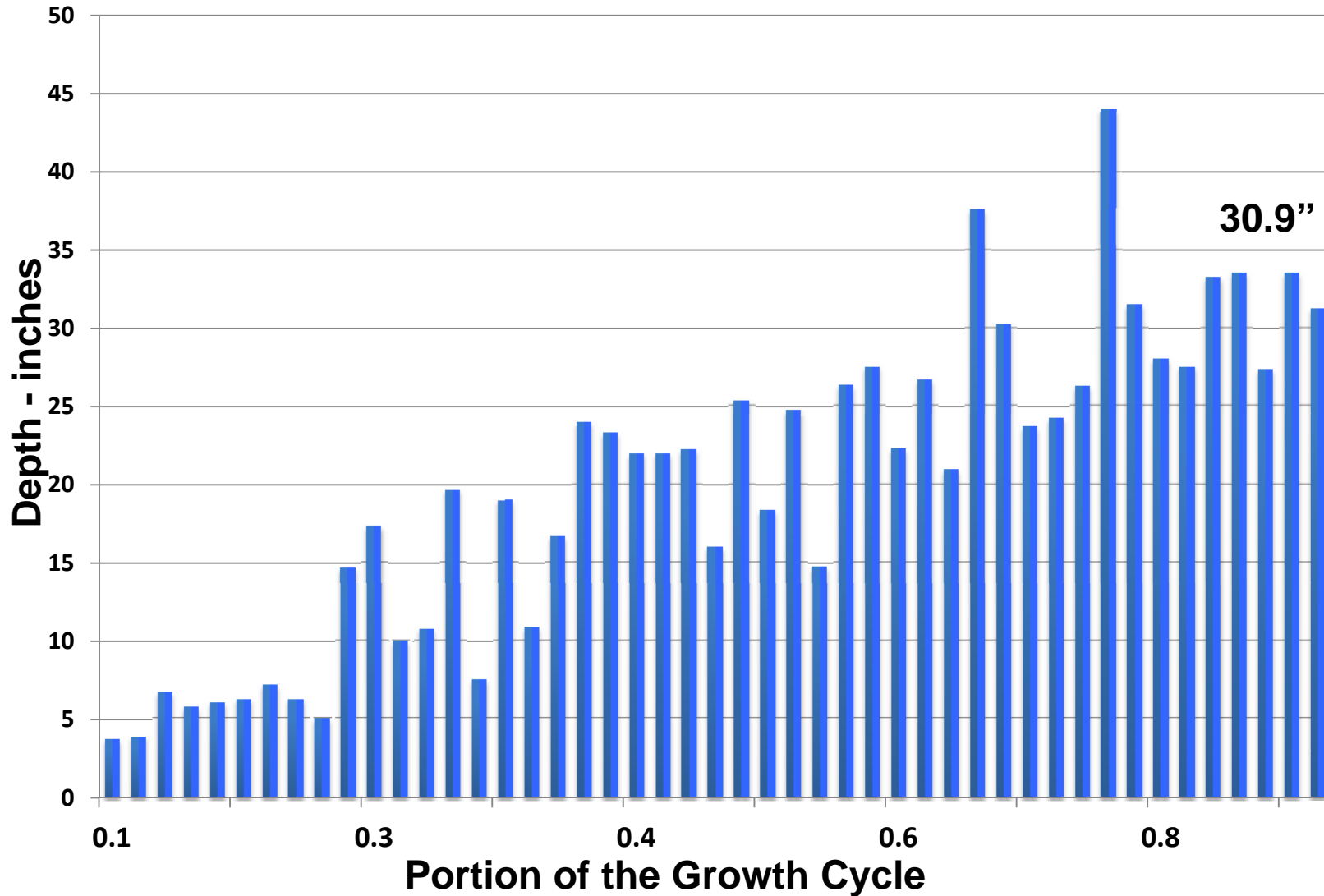
Cauliflower Rooting Depth



90 Day Old Cauliflower Roots



Cabbage Rooting Depth



Recommendations

- **Measure the levels of residual nitrate in the second foot early in the growth cycle of cole crops**
- **Given that broccoli is taking up nitrogen from the top two feet, this information will give you a better sense of what nitrogen resources are available for that crop**
- **Careful water management will be necessary to maintain the nitrate in the top two feet before the broccoli roots reach there**

Recommendations

- **All of the cole crops leave sizeable quantities of nitrate in their crop residue**
- **This nitrate will rapidly mineralize nitrate for subsequent crop use**
- **Again, careful irrigation will better assure that this nitrogen is available for subsequent crops that are shallower rooted**