Managing Potassium for High Yield

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Cropping system of interest

alfalfa

Art.com

corn

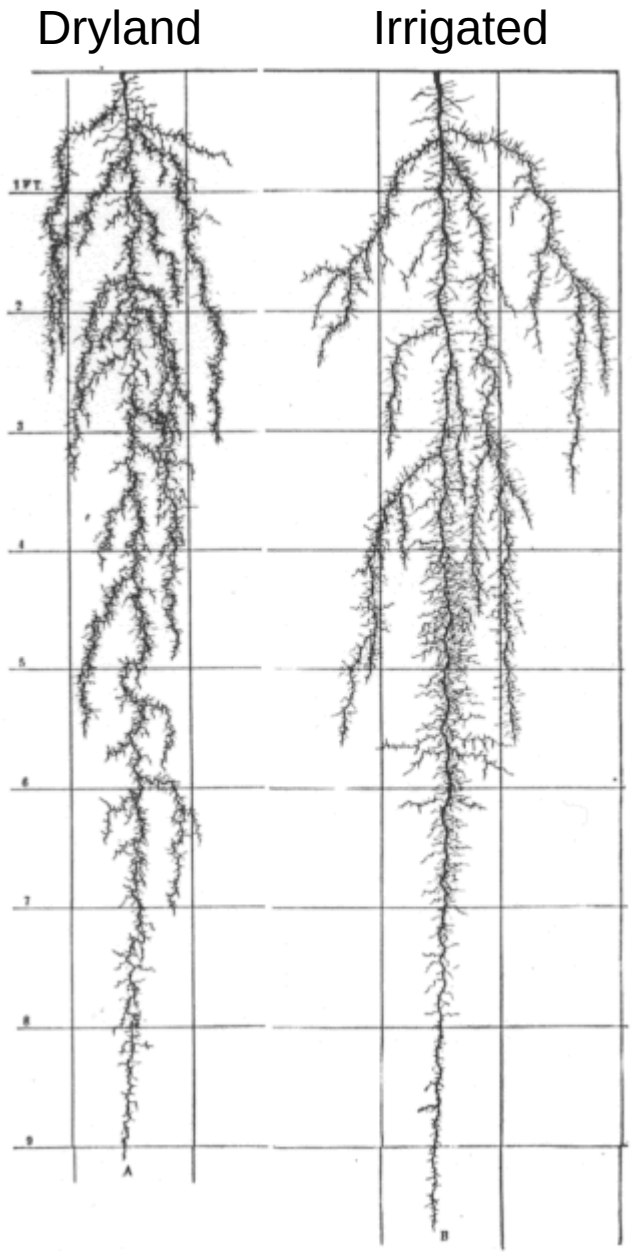
Ian Stevens, 2003

soybean

Purdue University

Alfalfa Root Morphology

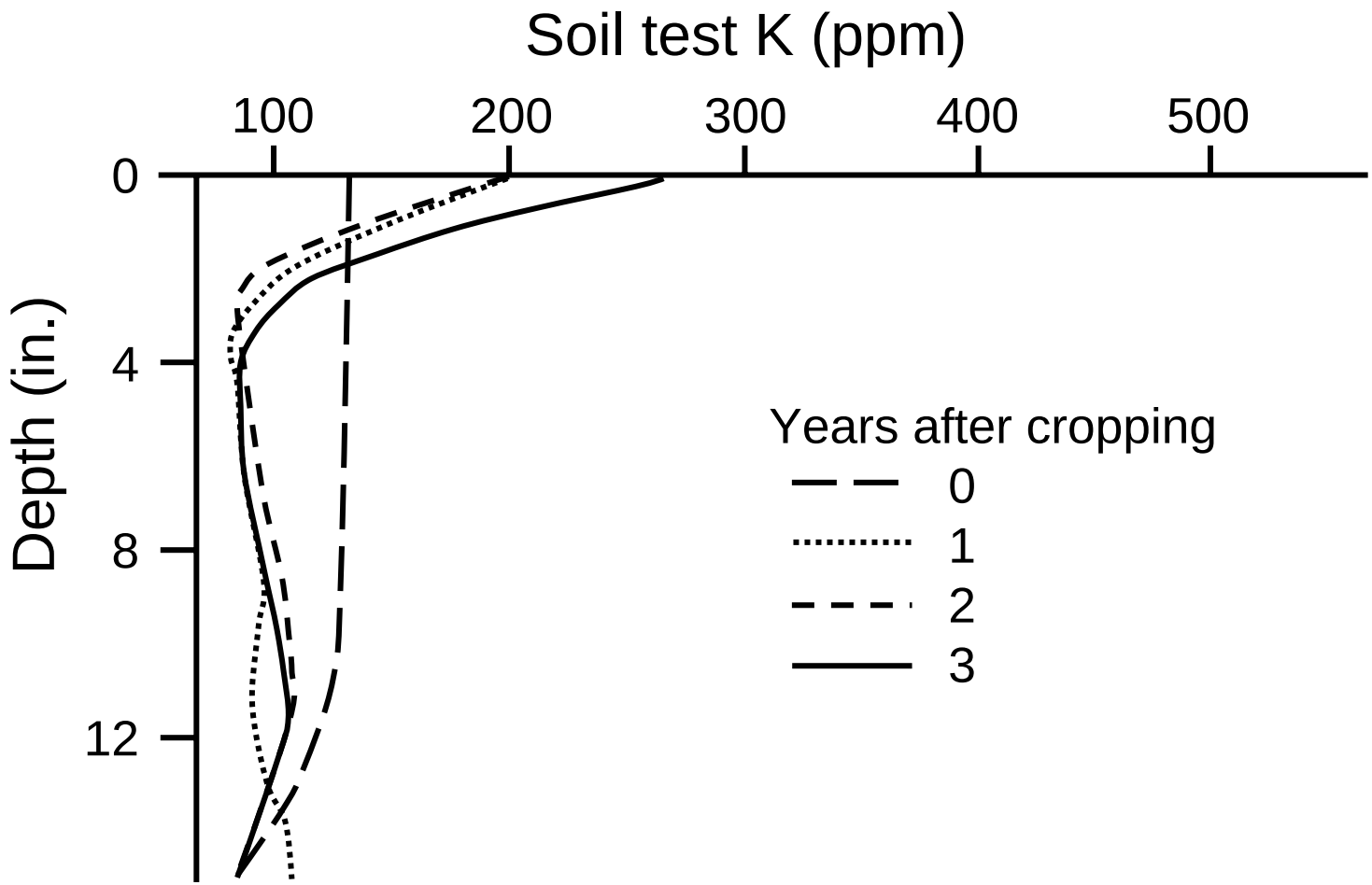
- Dryland:
  - Depth of over 9 ft.
  - Roots oriented downward
  - Little lateral extension
- Irrigated
  - Depth of nearly 10 ft.
  - Greater lateral extent



(July 10, second year)

Weaver, 1926 (Nebraska)

Effects of alfalfa cropping on soil test K



Fixen and Ludwick, 1983

Mass balance and soil test maintenance

- Mass balance:

  Nutrient input rate = nutrient removal rate

  - Inputs: fertilizer, manure, plant residues
  - Removals: crop harvest, erosion, runoff, leaching

- Soil test maintenance:

  Input rate required to maintain a soil test level

Is mass balance = soil test maintenance?

Soil	Initial soil test K level, 0-12 in. depth	Average annual removal of K_2O	K_2O required to maintain initial soil test level	Required/ removed
	(ppm)	(lb K_2O/A)		
Keith SiL	555	323	244	0.75
Ravola L	126	358	80	0.22

Fixen and Ludwick, 1983

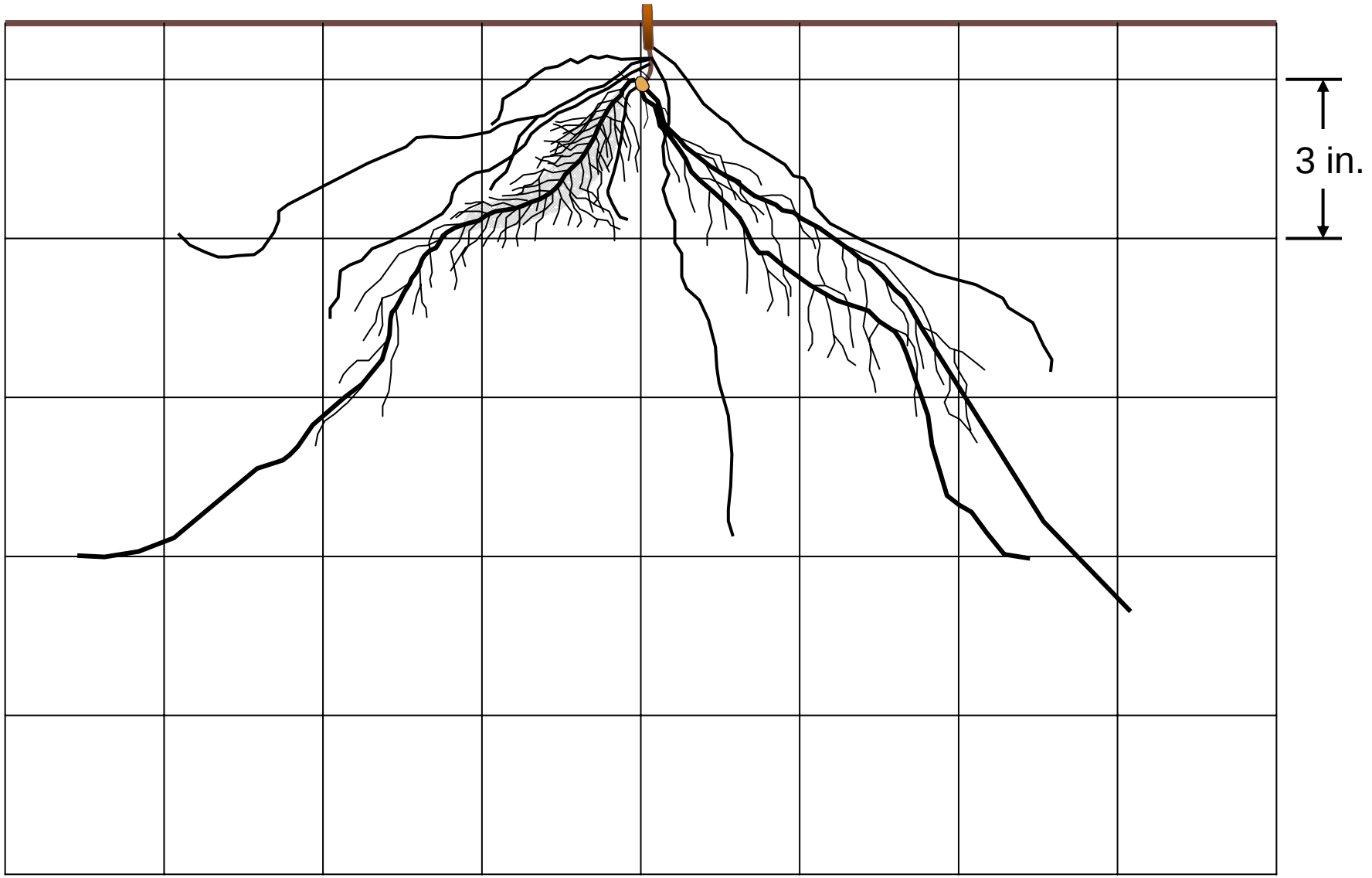
Implications

- It is possible for a soil test to remain steady while:
  - More K is taken out of the soil than is put back
  - K gets removed from lower parts of the soil profile where roots of future crops will be
  - K gets reallocated from lower in the profile to near-surface layers

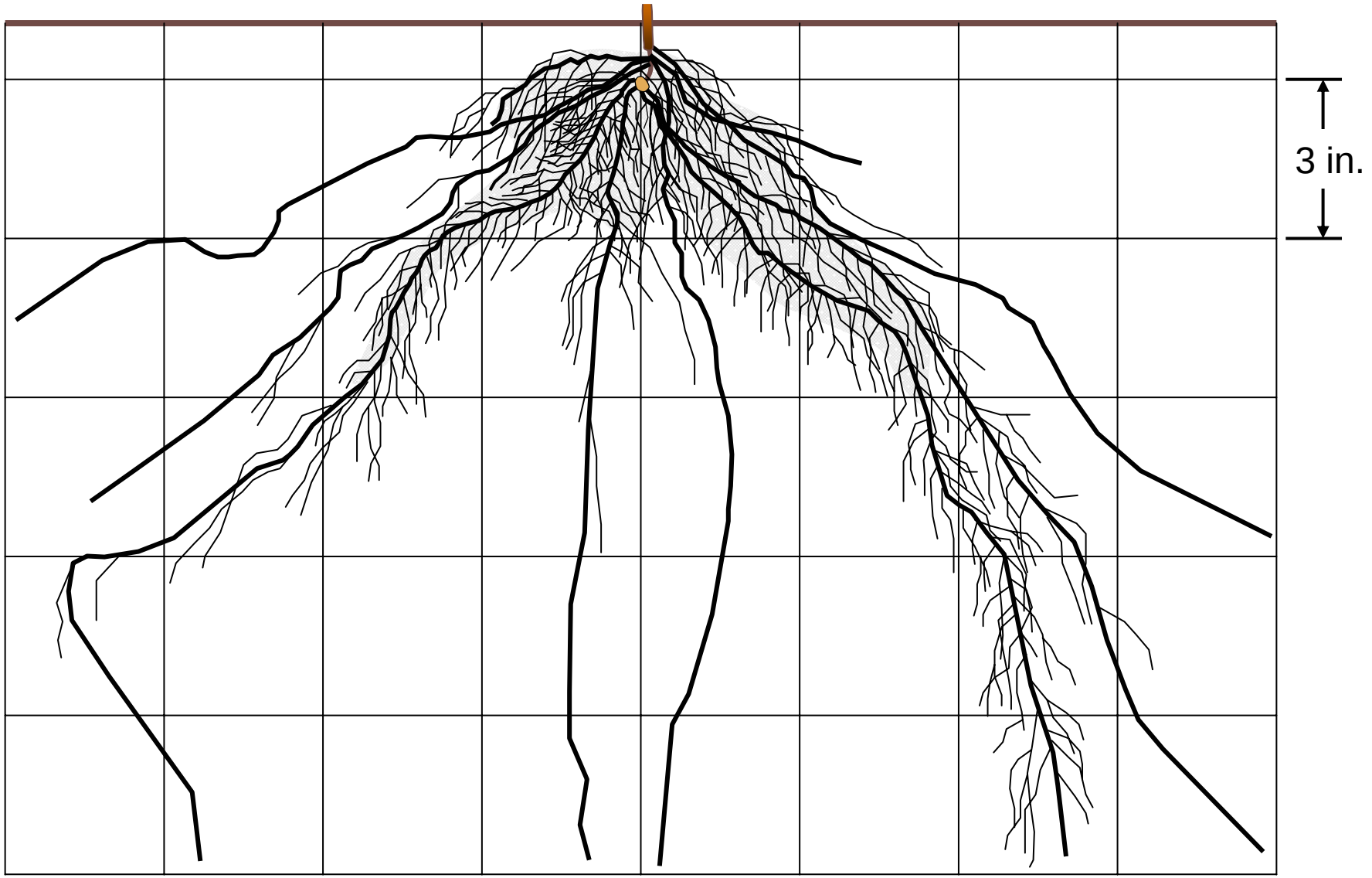
Example of K removal in a 5-yr crop rotation

Year	Crop	Yield	Yield units	K_2O removal
		(units)		(lb K_2O/A)
1	alfalfa	2	tons	98
2	alfalfa	4	tons	196
3	alfalfa	6	tons	294
4	corn	150	bu	41
5	soybean	40	bu	52
Total				681

Corn roots: V3

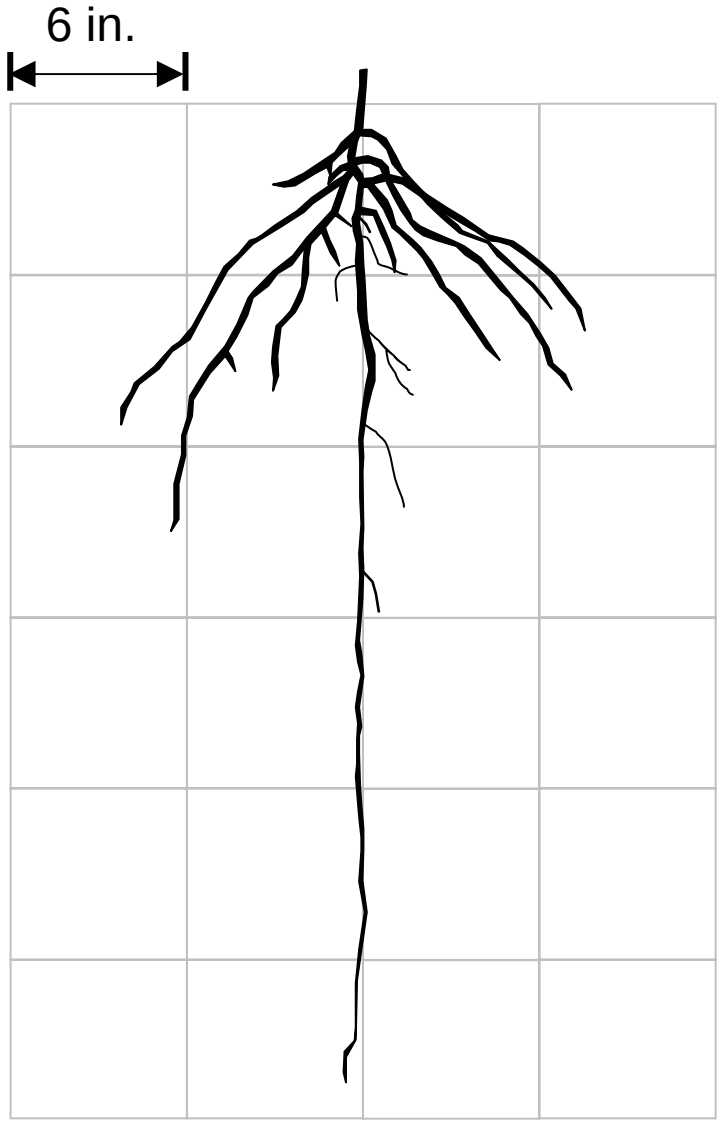


Corn roots: V5



Soybean root growth

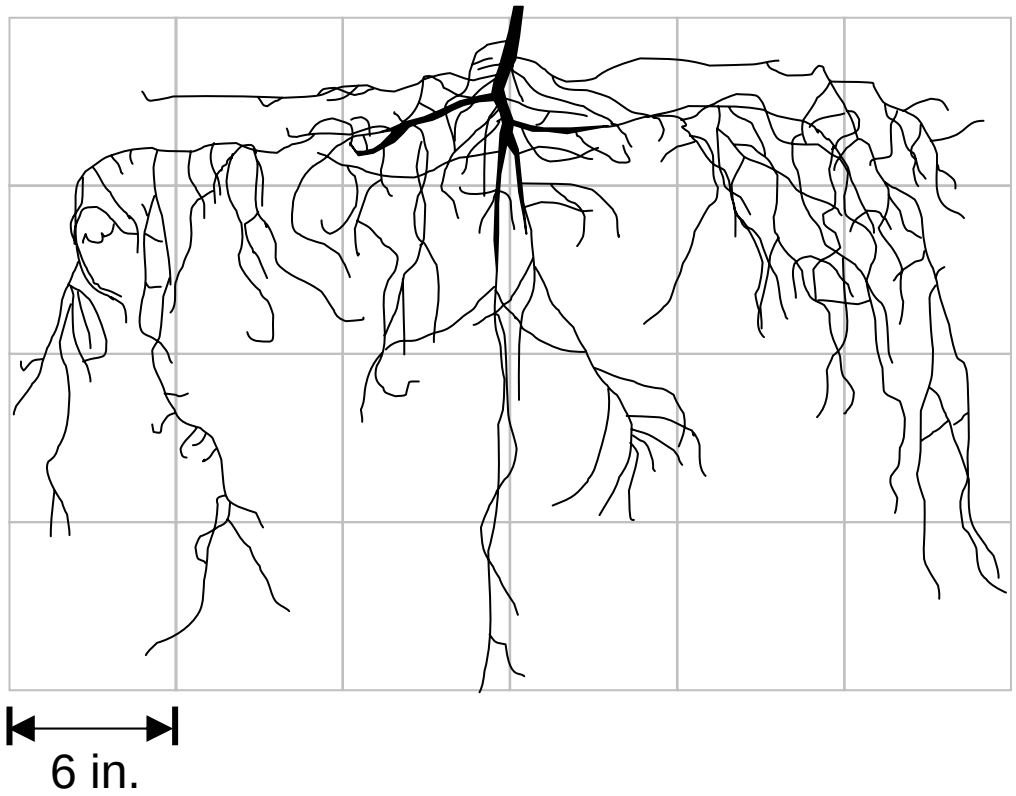
- Phase 1
  (1st month after planting)
  - Rapid vegetative top growth
  - Downward taproot growth
  - Development of horizontal laterals in upper soil profile



Mitchell and Russell, 1971

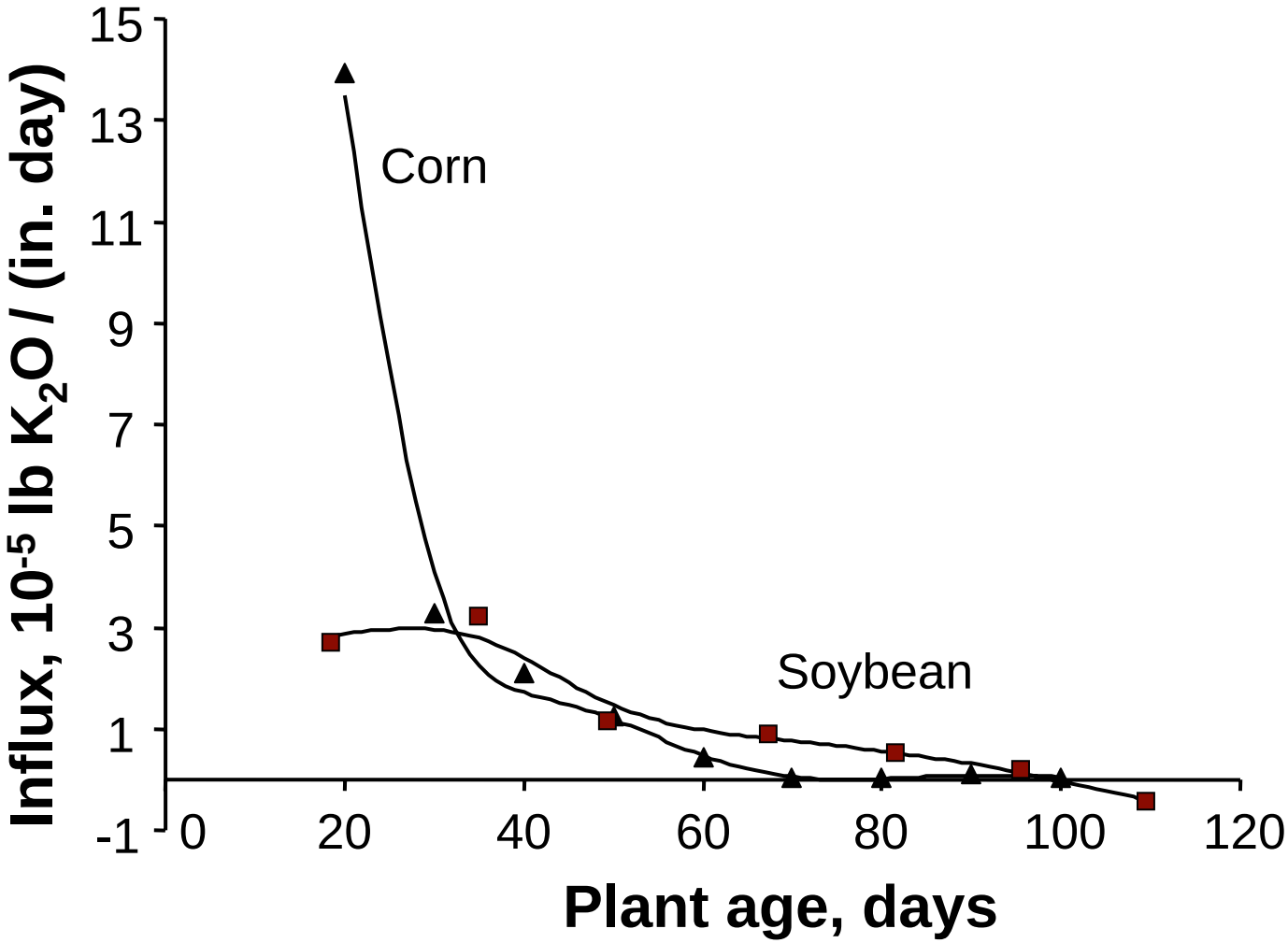
Soybean root growth

- Phase 2 (2 – 2.5 months after planting)
  - High rates of top growth (from flowering through pod formation)
  - More laterals develop in upper soil profile
  - Some laterals begin to turn downward



Mitchell and Russell, 1971; Raper and Barber, 1970

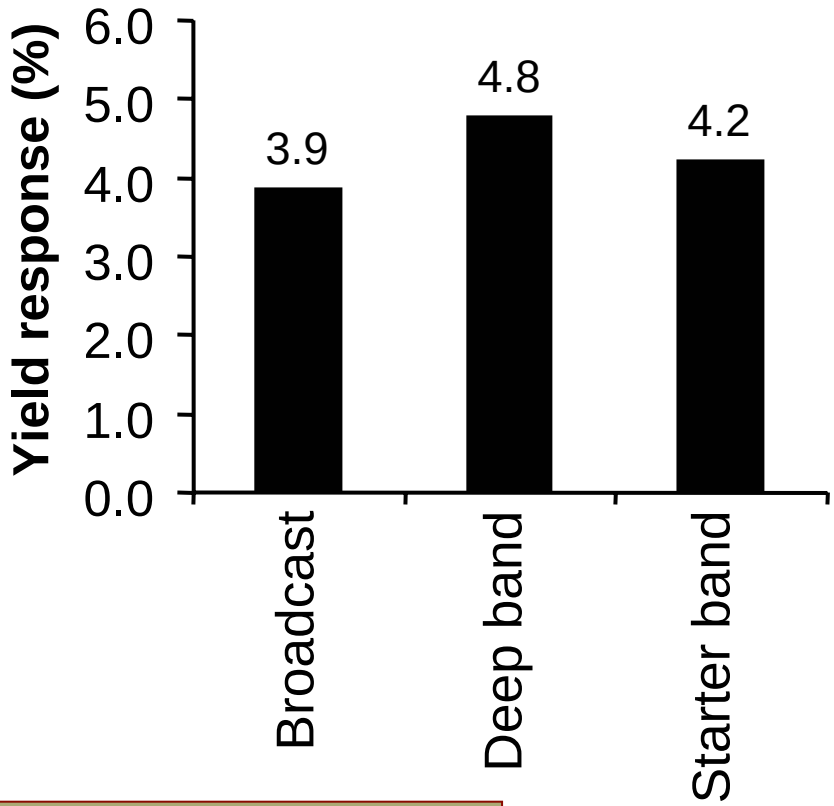
K influx varies with plant age



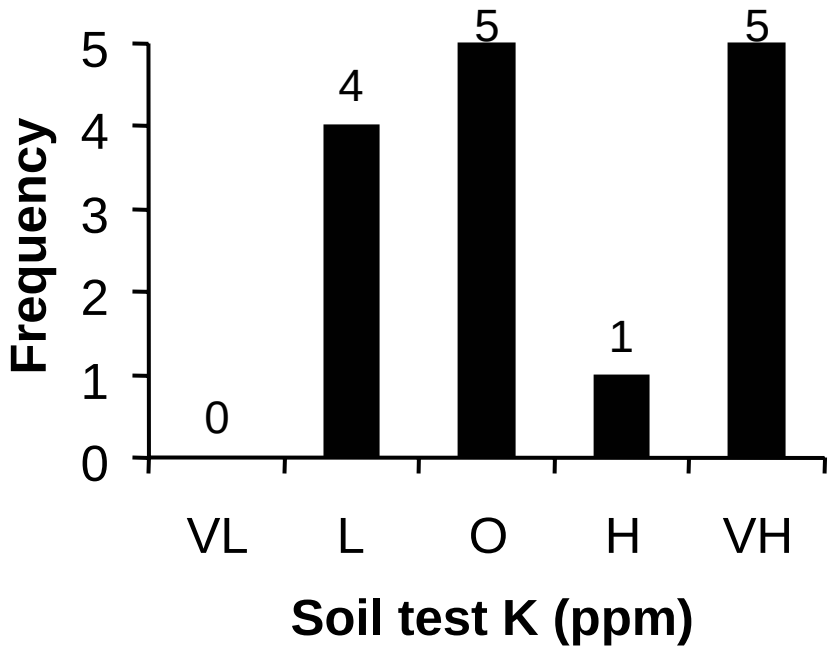
Barber, 1978; Mengel and Barber, 1974

No-till corn response to K placement

Research station sites

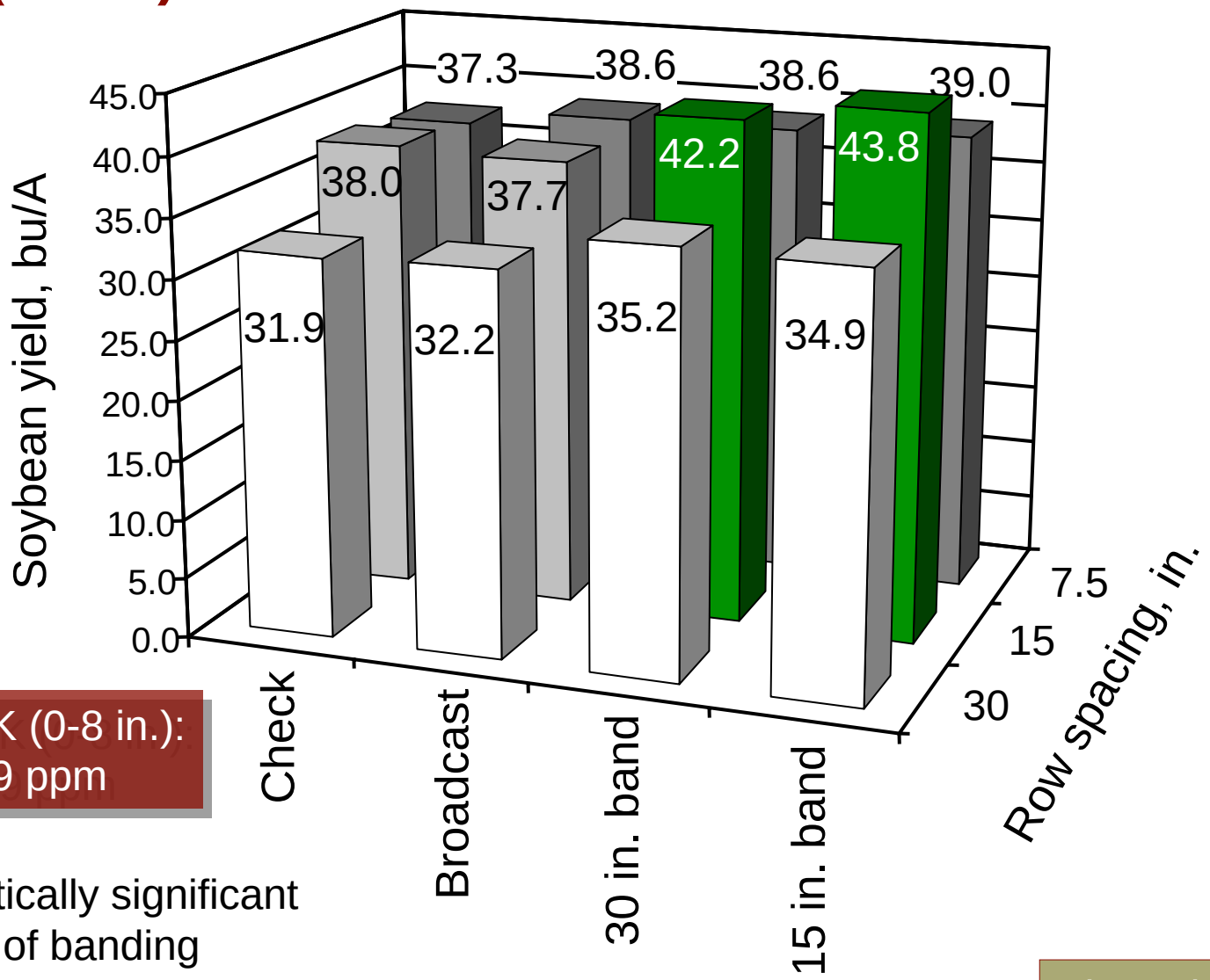


Distribution of soil test K across the 15 sites



Bordoli and Mallarino, 1998

Soybean row spacing and K band spacing interact (no-till)



Soil test K (0-8 in.): 33-49 ppm

Statistically significant effect of banding

Yin and Vyn, 2003

Questions to ponder

- If starter fertilizers are the only K source for corn following alfalfa, is the rate high enough to make up for the depletion of K in the subsoil during alfalfa cropping?
- Is the starter fertilizer placement used for corn also the best placement for soybean?
- What would be the long-term impacts of deep-banded K on the alfalfa/corn/soybean rotation?