FERTILITY MANAGEMENT FOR TOMATOES AND PEPPERS

2012 Wisconsin Fresh Fruit and Vegetable Conference, 1/16/12

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Learning for life

OUTLINE

Sulfur

Soil and plant testing

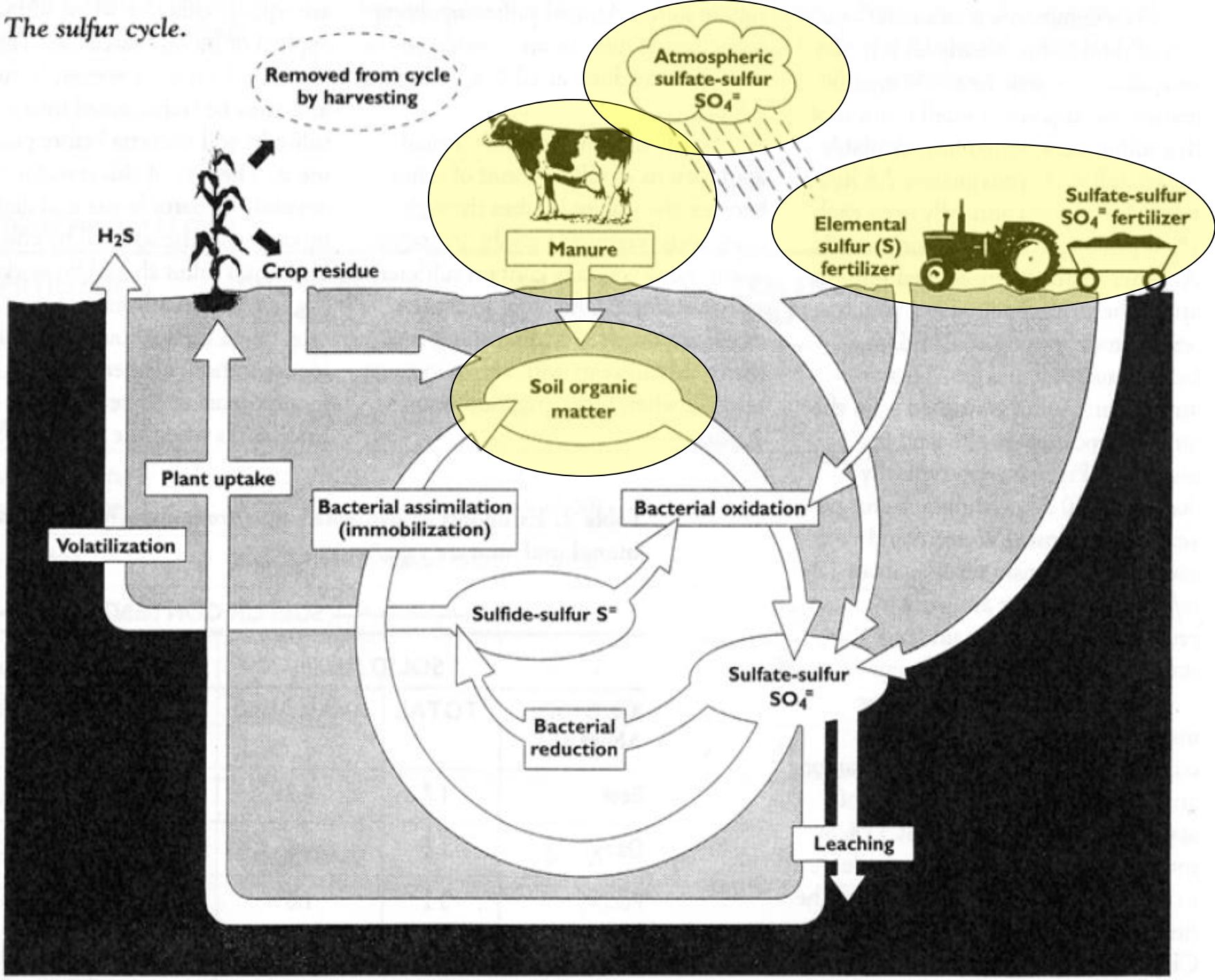
Tomato

- UW nutrient guidelines
- Nutrients of concern

Pepper

- UW nutrient guidelines
- Nutrients of concern

Figure 1. The sulfur cycle.



CONDITIONS THAT COULD RESULT IN SULFUR DEFICIENCIES

- Low organic matter soils (sands)
- No recent manure applications
- Less sulfur in rainfall
  - i.e. cleaner air
  - Traditionally more of a concern in N & W Wis.
- Low subsoil sulfur

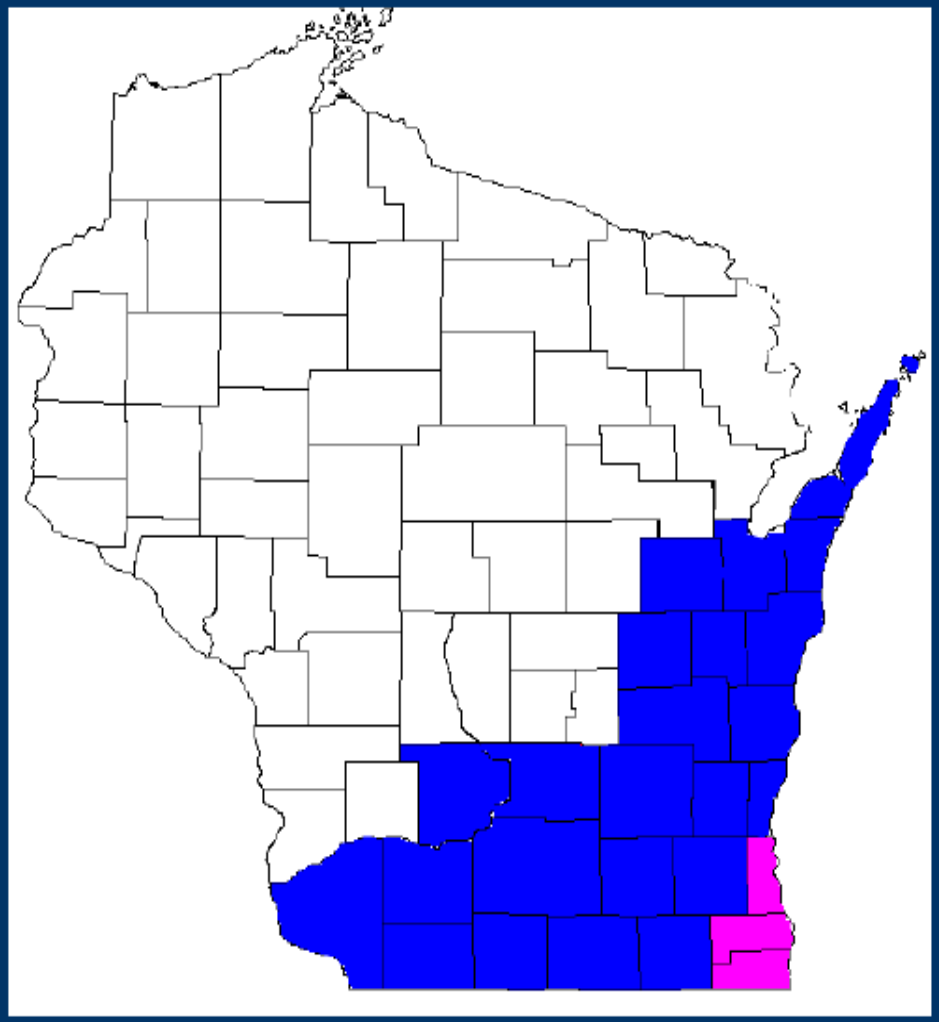
SULFUR AVAILABILITY INDEX (SAI)

- Formula for predicting the need for sulfur fertilizer.
- Estimates the amounts of sulfate-S from:
  - Topsoil
  - Organic Matter
  - Subsoil
  - Precipitation
  - Manure

SAI = SUM OF AVAILABLE S INPUTS

- Organic Matter: 2.8 lbs S/a per 1% OM
- Precipitation: 5, 10, or 15 lb S/a
- Subsoil: 5, 10, or 15 lb S/a
- Manure sulfur credit
  - Species & rate dependent
- Soil sulfate-S test (X 4)

Precipitation Sulfur Values for SAI



10 lb/a

5 lb/a

15 lb/a

SUBSURFACE SULFUR BY SOIL GROUP

(each soil type in WI is assigned a subsoil S code)

Soil group	Subsoil S code		
	L	M	H
	— lb S/a in the subsoil —		
A	5	10	10
B	5	10	10
C	5	5	10
D	5	5	10
E	5	5	—
O	—	—	20

SAI INTERPRETATION

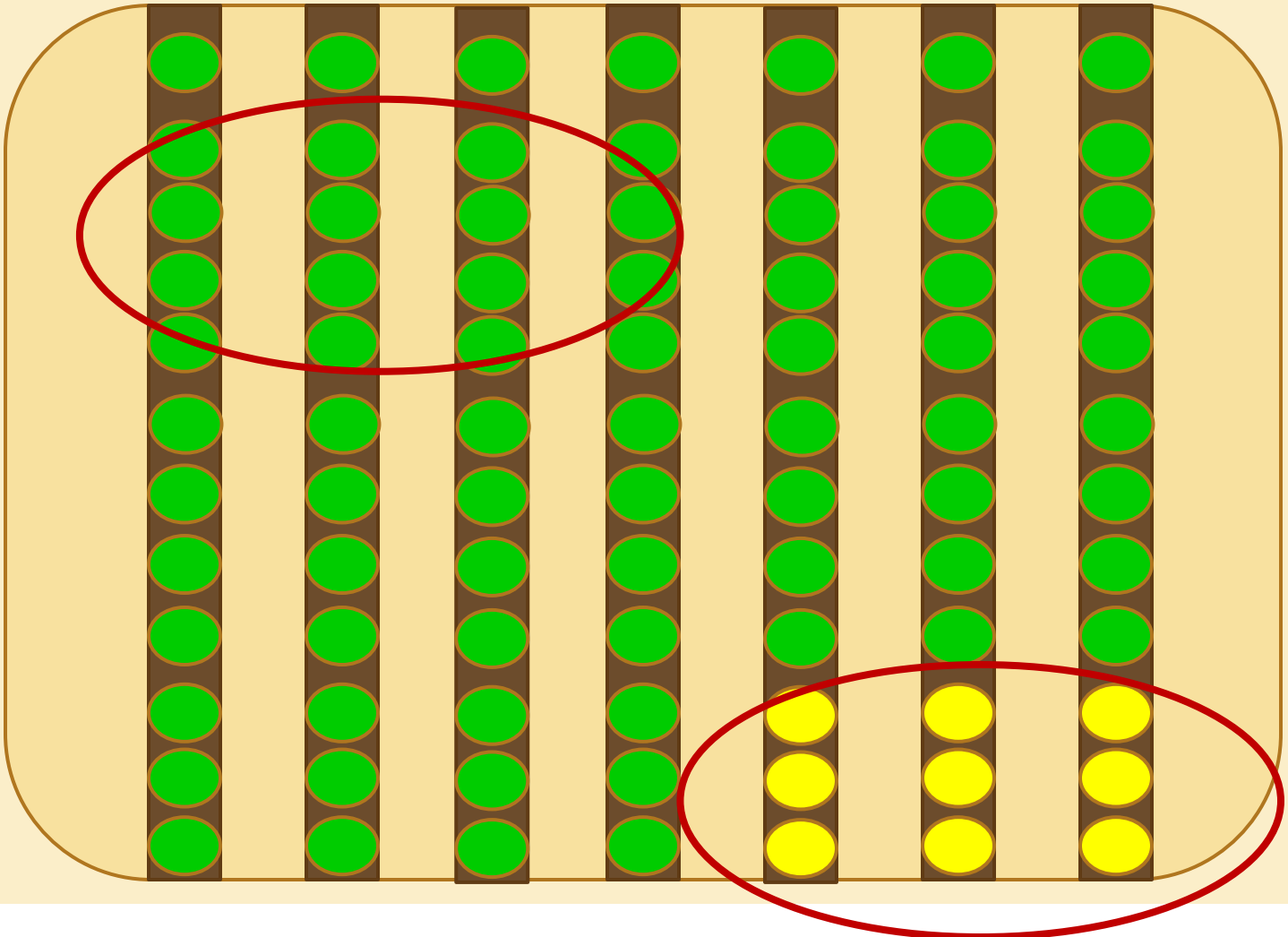
- SAI is < 30 (low), apply 10 to 25 lb-S/ac to vegetable crops.
- SAI is 30-40 (optimum), confirm need with plant analysis. If analysis is low, apply as above.
- If SAI > 40 apply no S.

SOIL AND PLANT TISSUE TESTING

- Soil tests let you know where to start
- Monitoring plant "health" helps to know how to adjust.
- Not all micronutrients have soil tests
- Not all nutrient deficiencies are caused by lack of soil nutrients

SOIL AND PLANT TISSUE TESTING

Take soil sample from area where plant samples were taken



Compare "bad" and "good" parts of the field – improves the diagnosis!

PLANT TISSUE SAMPLING

Recommendations for sampling:

- Tomato: collect mid-season, newest fully developed leaf, 40 plants/sample
- Pepper: collect prior to or at early fruit development, collect petiole **and** leaflet, 40 plants/sample
- Wipe off dirt, do not wash!
- UWEX does not have recommendations for petiole sap testing for pepper

ORGANIC MATTER & pH

- The OM measure helps place soil into category for N recommendation:
- <2%, 2 to 10, 10 to 20, >20
- Target pH for tomatoes and peppers:
- 6.0 for mineral soil
- 5.6 for organic soil

TOMATO

- Nitrogen (N)
- Recommendations based on 20-25 tons per acre of fresh weight yield

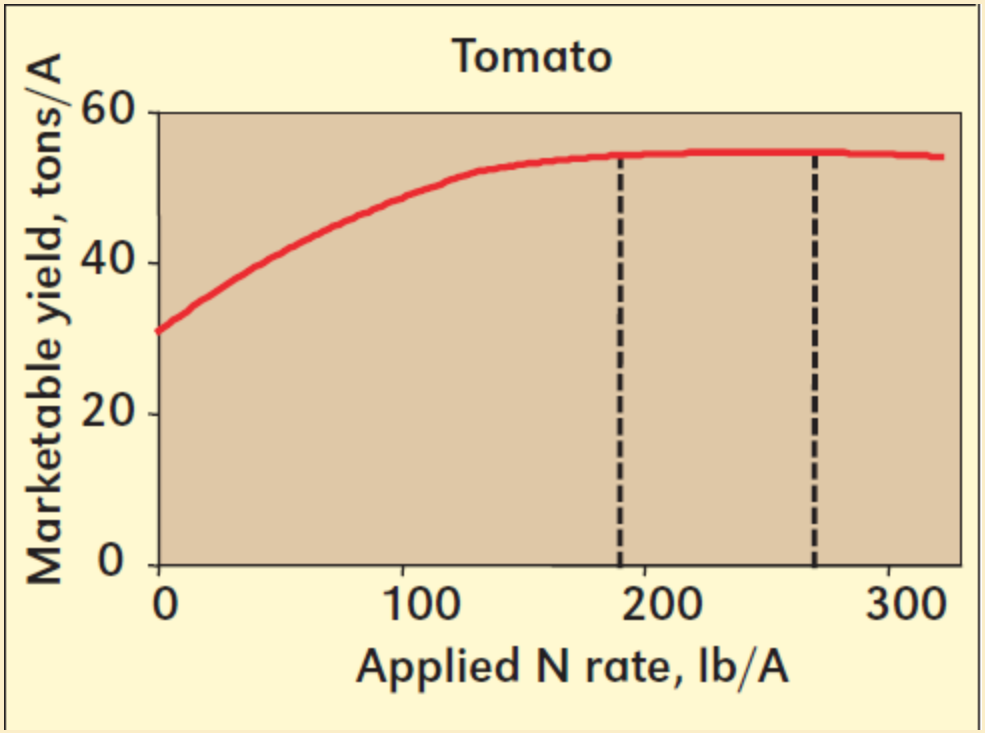
Organic Matter (%)	N rate
<2%	140
2 to 10	120
10 to 20	100
>20%	50

TOMATO

- Nitrogen (N)
- Sandy soil – consider split application, some preplant (20 to 40), remainder at or after first fruit set.
- The best split-applications may be more of an art than science.
- Goal is to maximize efficient use of N, while not over-promoting vegetative growth.

TOMATO

- What are your yields?
- Example: Data from Ontario, Canada



TOMATO

- P and K
- P: 1.8 lb P_2O_5 removal = 1 ton yield
- K: 8.0 lb K_2O removal = 1 ton yield

	VL	L	Opt	H	VH	EH
	lb of P_2O_5/ac					
P	115	90	40	20		0
	lb of K_2O/ac					
K	280, 305	240, 265	180	90	45	0

TOMATO

Ca, Mg, S

- Follow soil tests, plant tissue tests if needed
- Liming materials may contain adequate amounts of Ca or Mg
- Gypsum is a good source of Ca & S
- …but remember, gypsum will not change pH!

LIMING MATERIALS

- Dolomitic = $CaCO_3 \bullet MgCO_3$
- Calcitic = $CaCO_3$
- Fly ash = CaO, $Ca(OH_2)$, $CaCO_3$
- Gypsum = $CaSO_4$

$$CaCO_3 + 2H^+ = Ca^{2+} + CO_2 + H_2O$$

The carbonate affects the pH – not the calcium!

TOMATO

Micronutrients

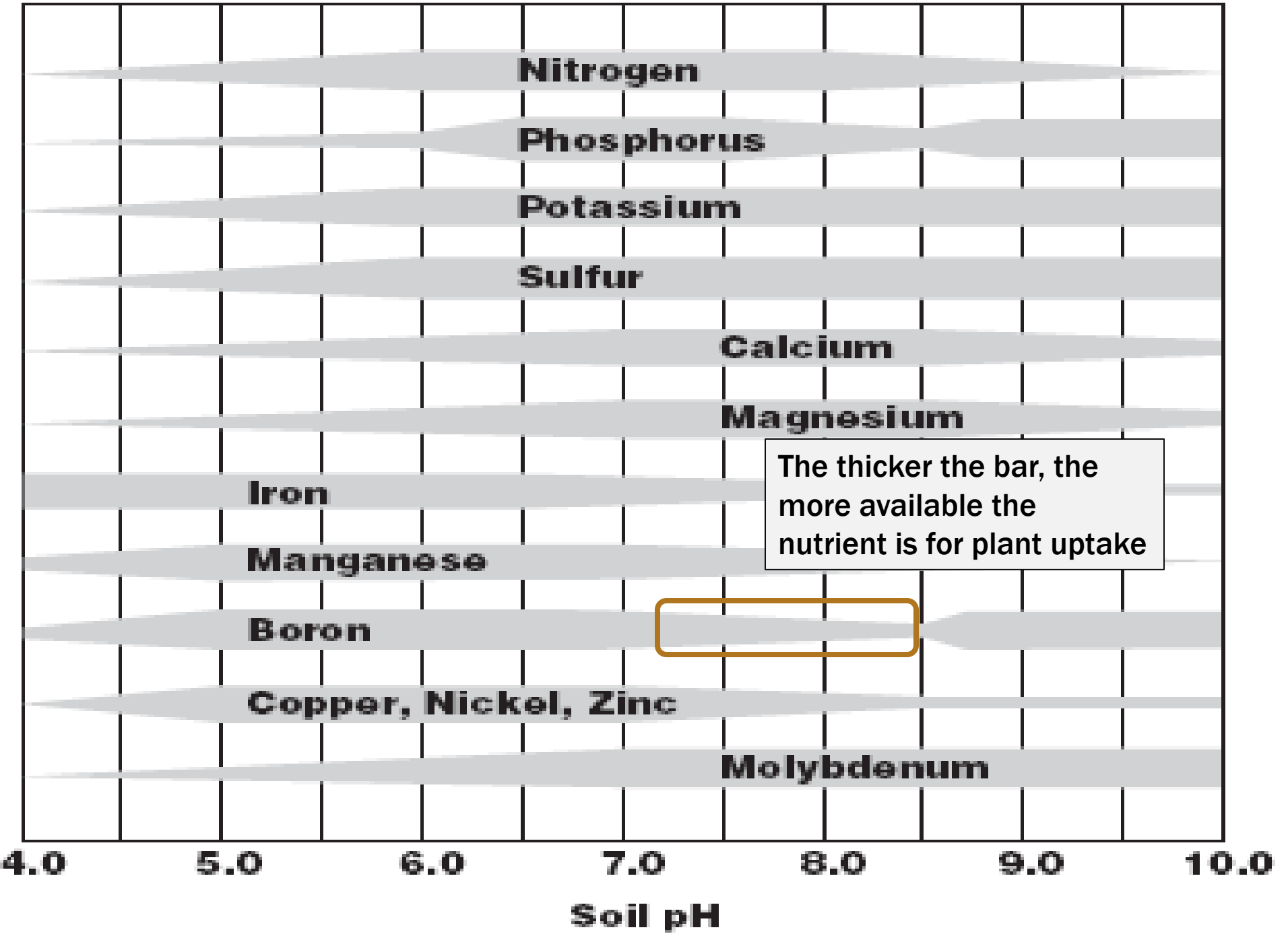
- Follow with plant tissue tests
- Boron and Copper are of main interest
- Foliar application of B not as effective, difficult to translocate out of plant tissue
- …but foliar is often the only application method in-season.
- …but B can be toxic at high levels – apply B, follow tissue samples, stop B applications when B becomes excessive

TOMATO

Importance of B

studies have shown…

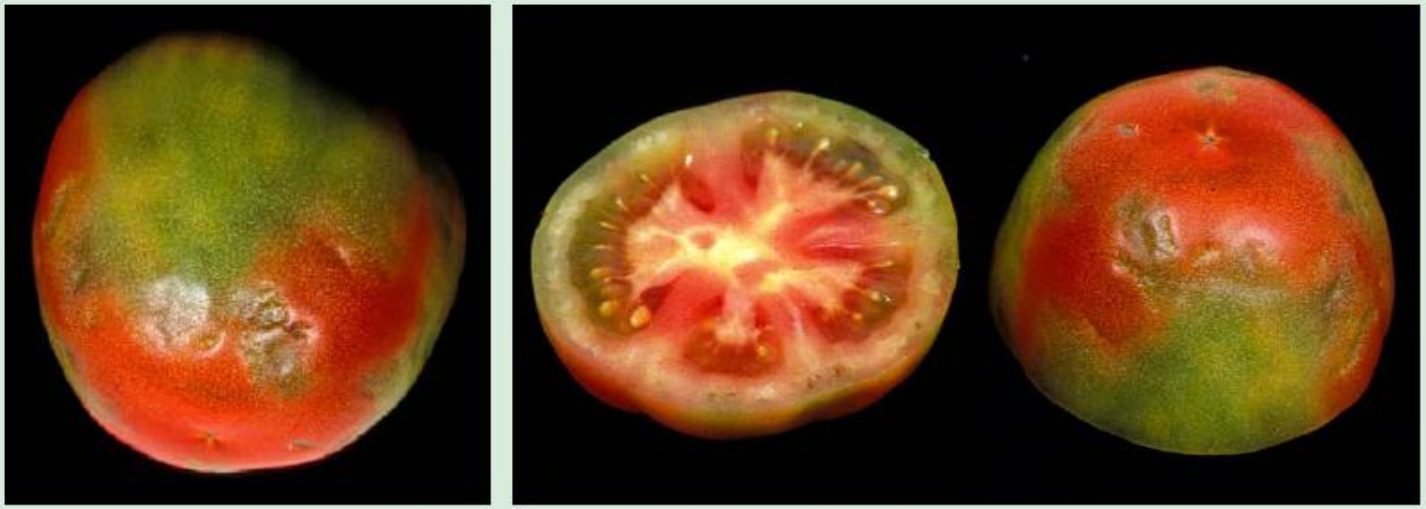
- Application of B increases K in leaf tissue and fruit
- Increases yields
  - Especially at high pH (>7.5)
  - At soil B concentrations of1.5 and 0.1 ppm - both showed a response to application in high pH soil (Huang and Snapp, 2009; MI)


Nitrogen
Phosphorus
Potassium
Sulfur
Calcium
Magnesium
Iron
Manganese
Boron
Copper, Nickel, Zinc
Molybdenum
The thicker the bar, the more available the nutrient is for plant uptake
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Soil pH

TOMATO

- Gray wall or blotchy ripening
- Associated with:
- Low K, low B, high N

How to Identify Graywall



Fruit is uneven in color, both inside and outside, with hardened patches of grayish or yellowish tissue.

PEPPER

- Nitrogen (N) rate
- Based on yield goal of 8-10 tons ac^{-1}

Organic Matter (%)	N rate
<2%	100
2 to 10	80
10 to 20	60
>20%	30

PEPPER

- P and K
- P: 1.1 lb P_2O_5 removal = 1 ton yield
- K: 5.6 lb K_2O removal = 1 ton yield

	VL	L	Opt	H	VH	EH
	lb of P_2O_5/ac					
P	85	60	10	5		0
	lb of K_2O/ac					
K	150, 175	110, 135	50	25	15	0

PEPPER

- UW recommendations do not rank secondary micronutrients for pepper.
- Use plant tissue testing

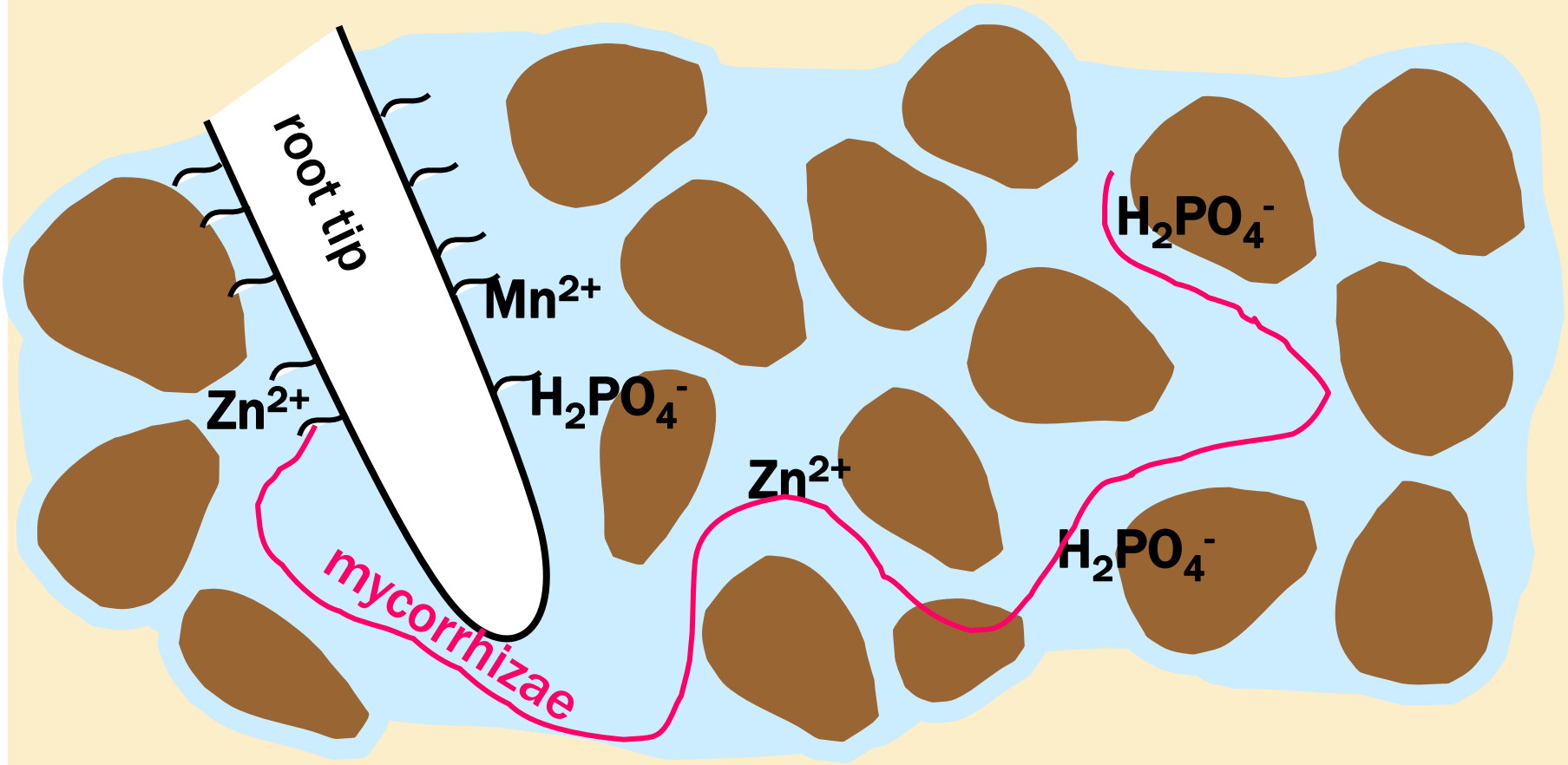
PEPPER & TOMATO

Blossom end rot

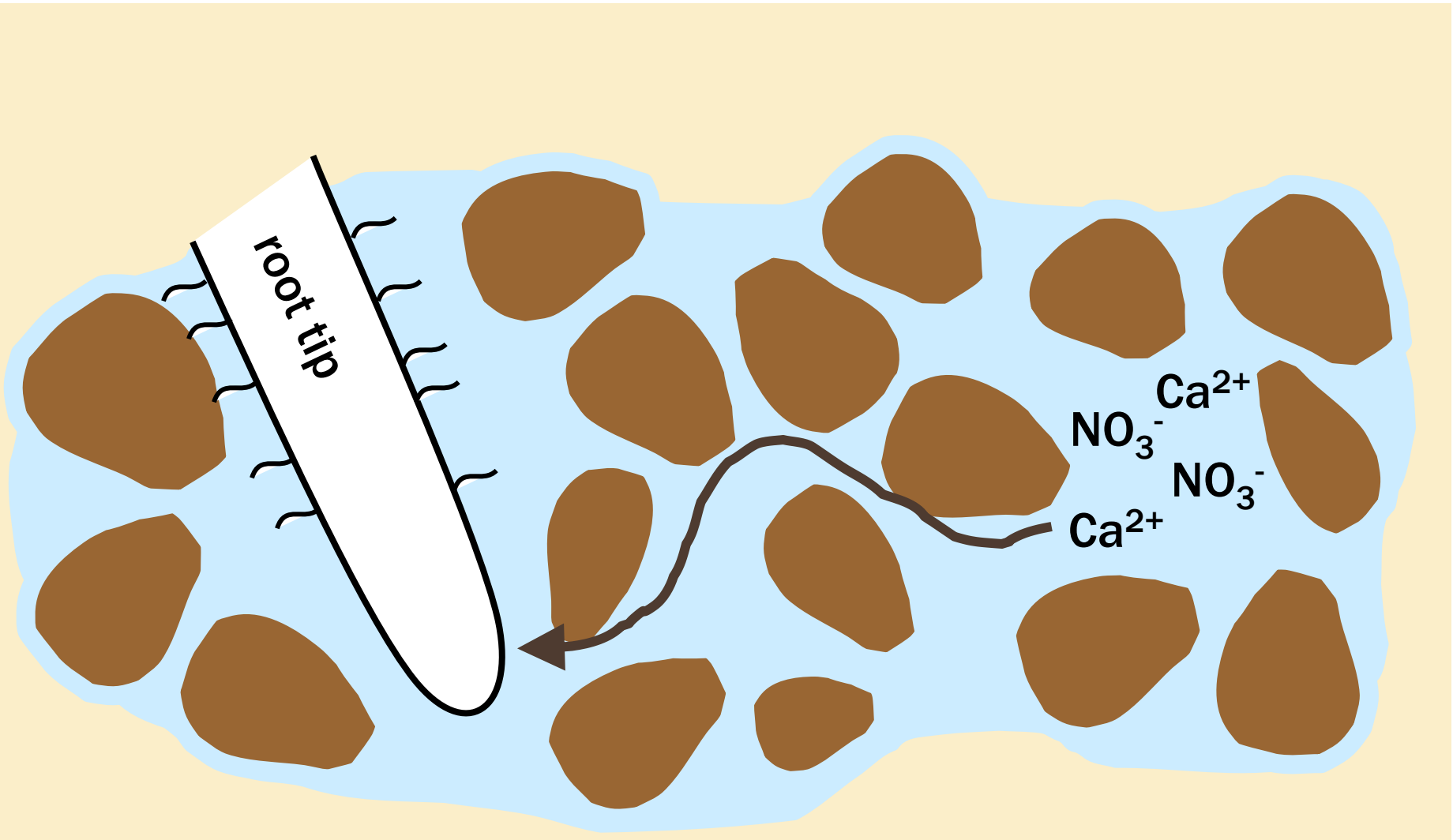
- Related to Ca deficiency
- Caused by low Ca fertility
- Caused by water stress
- Caused by excessive N or K fertilization
  - N encourages excessive vegetative growth
  - K leads to high soluble salt concentrations in soil and can restrict water uptake and thus Ca.
- Caused by anything that damages roots

Root interception – roots obtain nutrients by physically contacting nutrients in soil solution or on soil surfaces;

- roots contact ~1% of soil volume;
- mycorrhizal infection of root increase root-soil contact

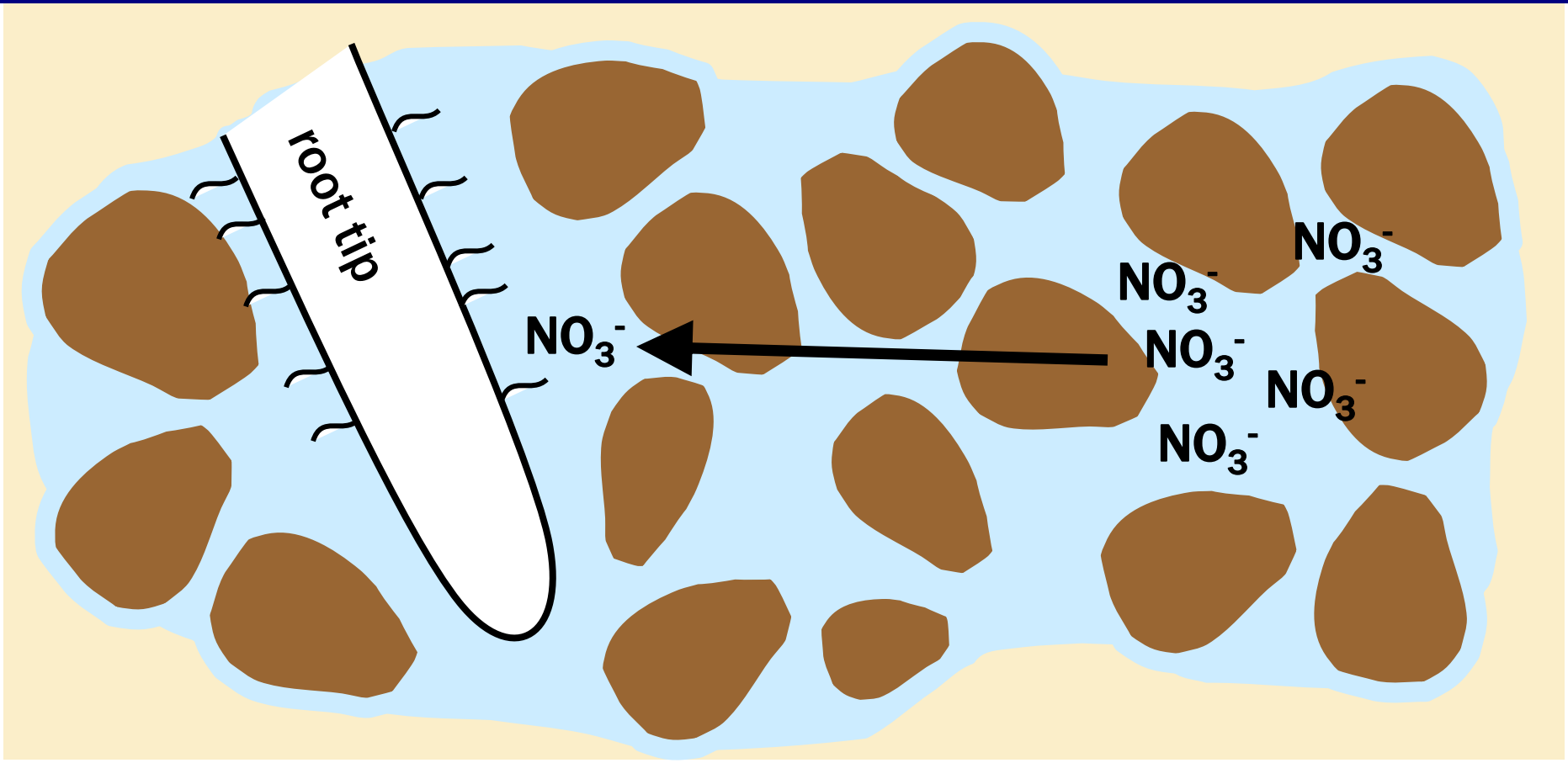


Mass flow – dissolved nutrients move to the root in soil water that is flowing towards the roots



Diffusion – nutrients move from higher concentration in the bulk soil solution to lower concentration at the root;

-In the time it takes NO_3^- to diffuse 1 cm, K^+ diffuses 0.3 cm, and $H_2PO_4^-$ diffuses 0.05 cm



TAKE HOME MESSAGES

- Over-application of N = bad
- Under-application of K = bad
- Sulfur – nutrient to watch!
- To avoid fruit quality issues, use plant tissue and soil testing for:
  - Boron
  - Calcium

QUESTIONS?
THOUGHTS?
CONCERNS?
COMPLAINTS?

REFERENCES

- Foliar B application to field tomato (IA)
- http://www.public.iastate.edu/~taber/Extension/Progress%20Rpt%2002/foliarB.pdf
- Fertilization of Pepper in FL (info on petiole sap testing)
- http://groups.ucanr.org/nutrientmanagement/files/78468.pdf