Introduction of the Short Course

Basics of Nitrogen in Plant and Soil and

Topics Covered and Not Covered by Todays' Seminar

Organic Soil Fertility for Vegetables and Strawberries
University of California Short Course. Feb. 12, 2019, Salinas, CA

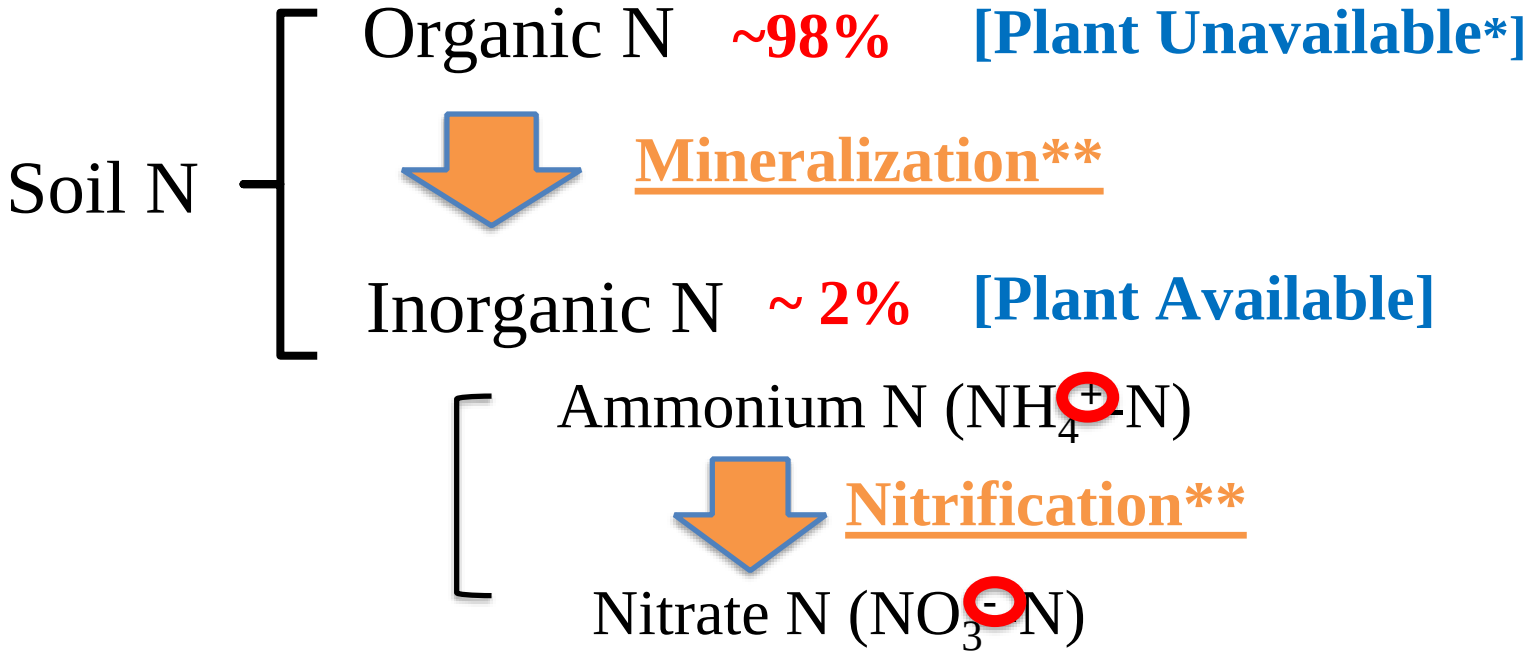
Joji Muramoto

UC Santa Cruz

N in plants; A key to crop production

- *Primary nutrient affecting plant growth*
  - *photosynthesis (chlorophyll)*
  - *biomass structure (protein)*
  - *metabolism (enzyme)*
  - *energy production (ATP)*
  - *reproduction (DNA, RNA)*
- *N deficiency*
  - *Yellowish green leaves, smaller plants, lower yield*
- *N excess*
  - *Dark green leaves, large plants, susceptive to diseases*

N Forms in Soil and Plant Availability

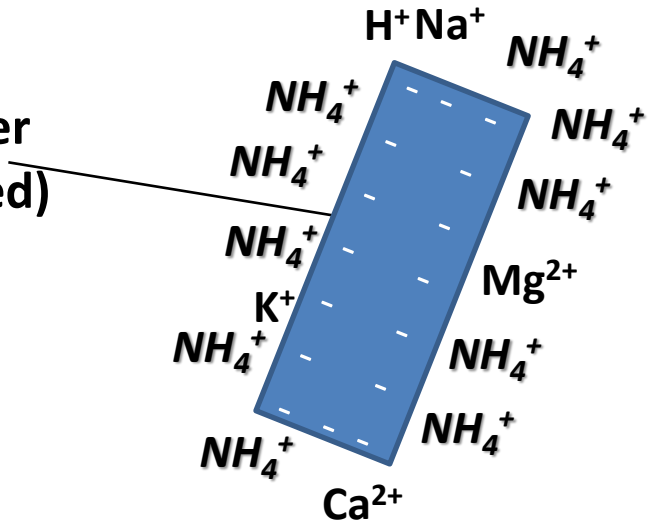


* Plants can absorb small amounts of organic N and some crop plants can do more than others

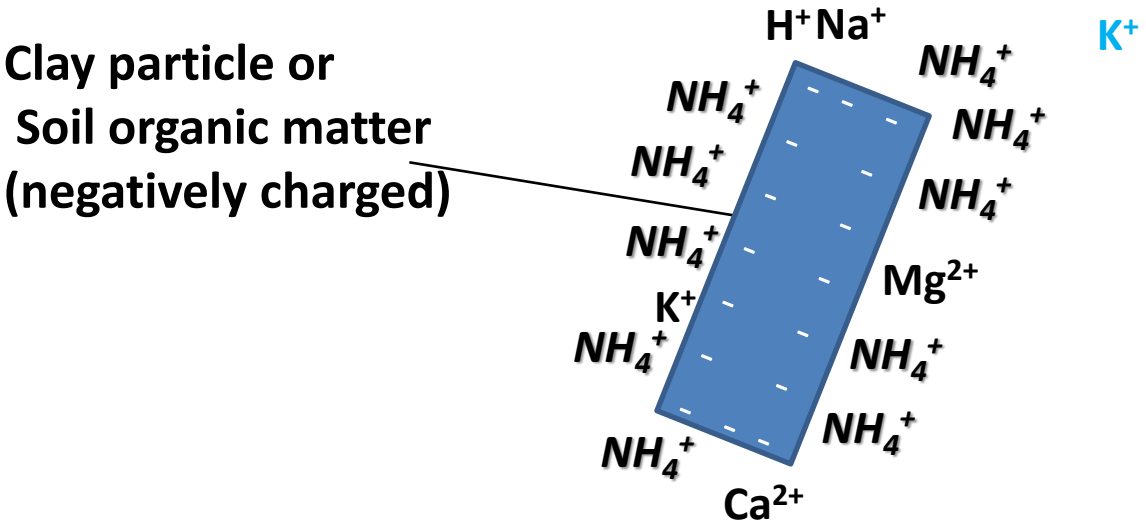
** **Biological processes** affected by ***environmental factors*** such as ***soil temperature. moisture, pH, oxygen content etc.***

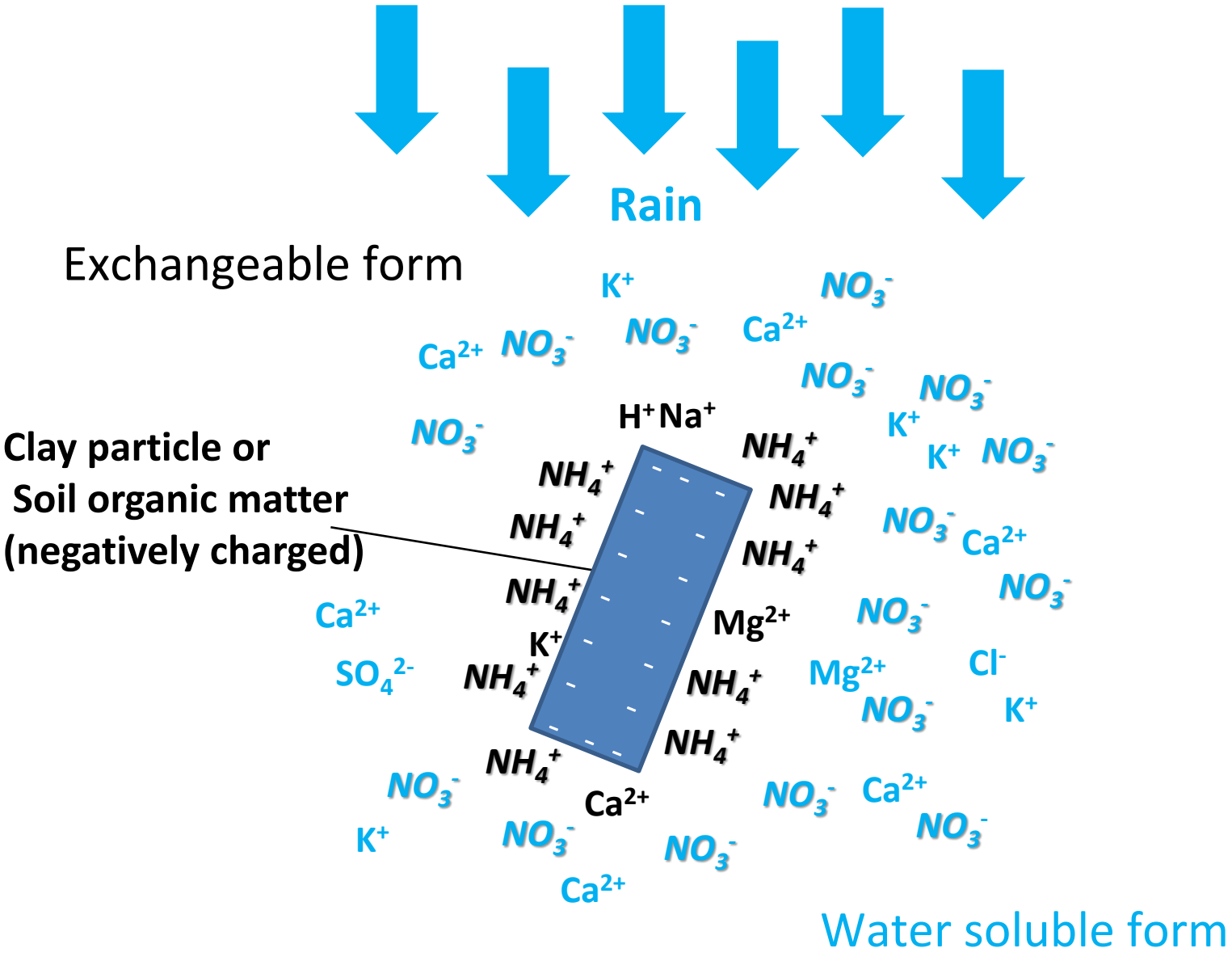
Exchangeable form

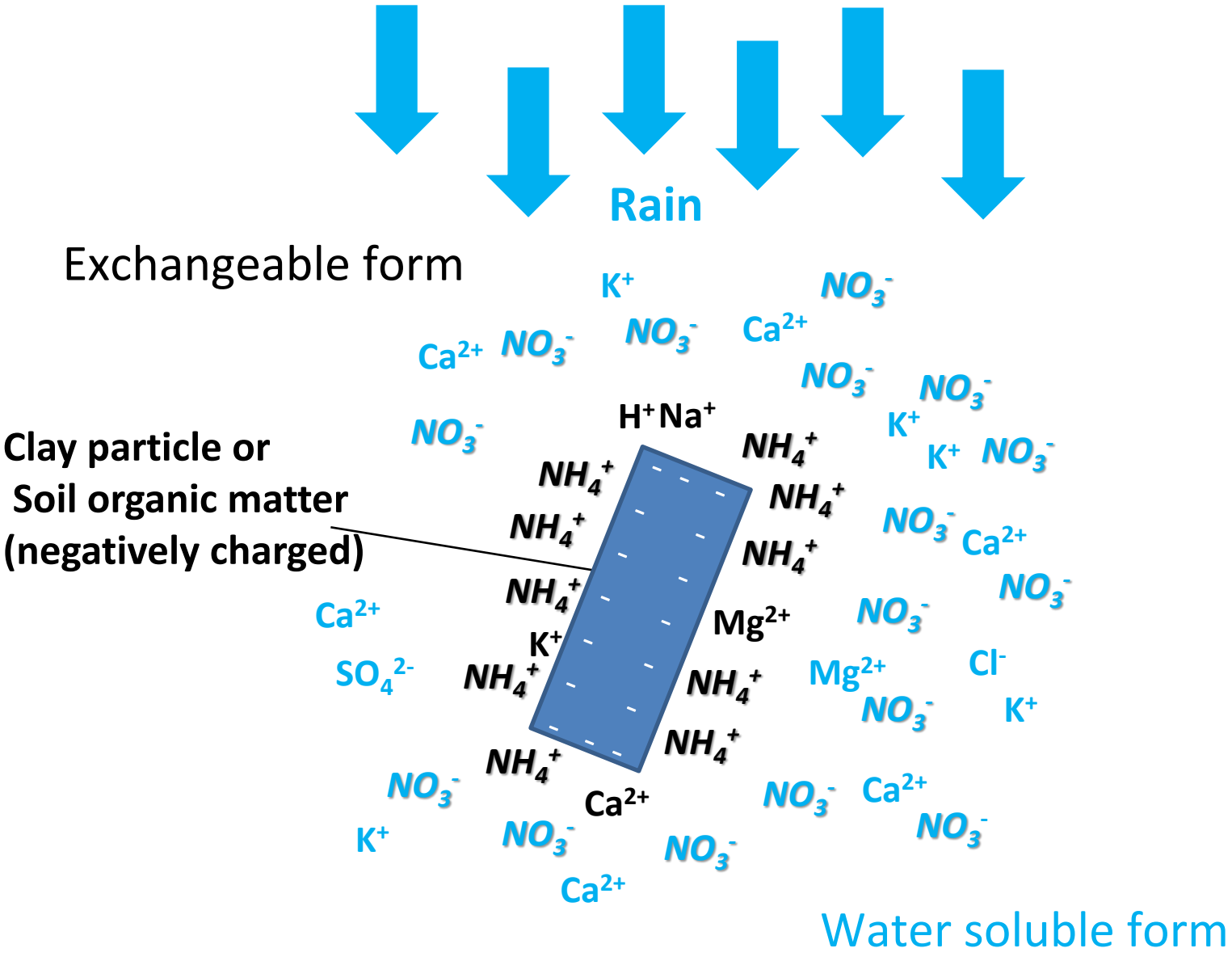
Clay particle or
Soil organic matter
(negatively charged)



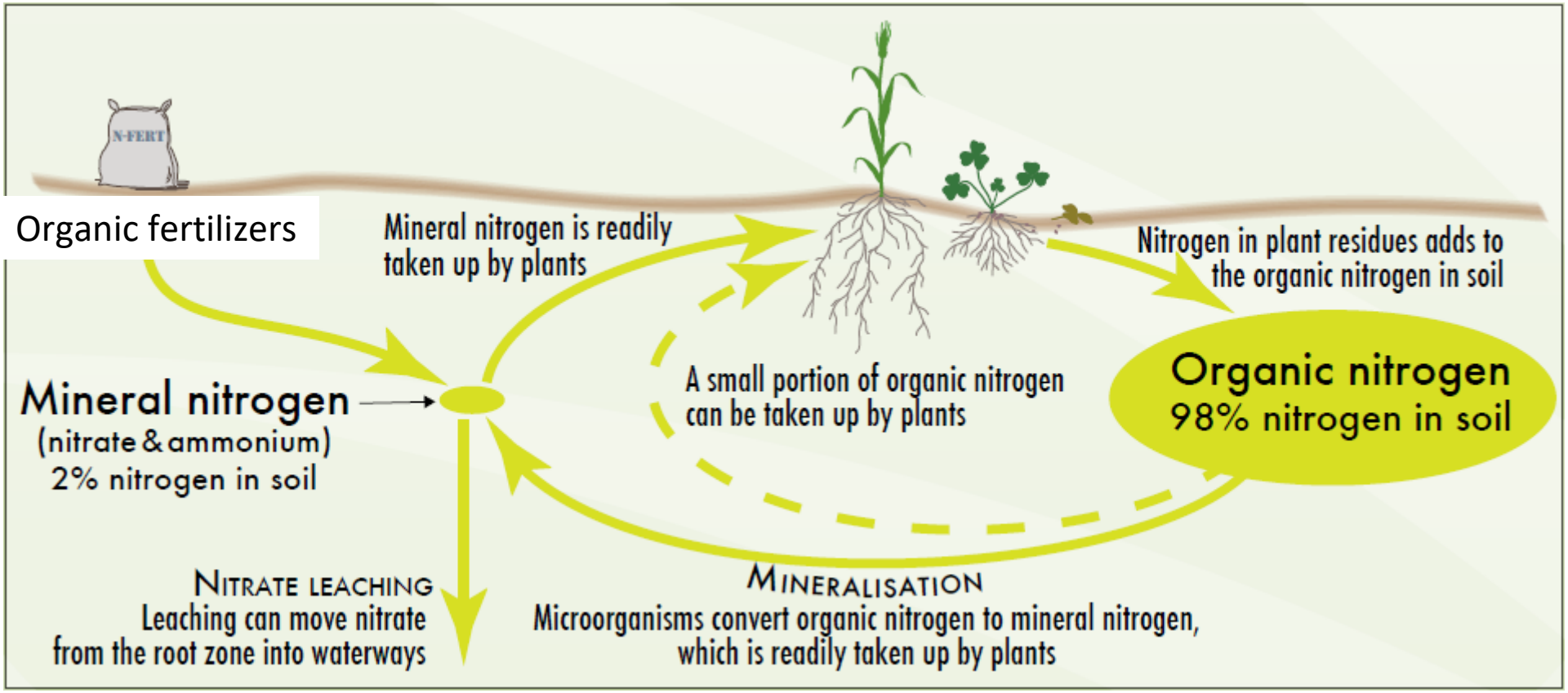
Exchangeable form




Rain
Exchangeable form
Clay particle or
Soil organic matter
(negatively charged)
Water soluble form
K^+
NO_3^-
Ca^{2+}
H^+ Na^+
NH_4^+
Mg^{2+}
SO_4^{2-}
Cl^-


Rain
Exchangeable form
Clay particle or
Soil organic matter
(negatively charged)
Water soluble form
K^+
NO_3^-
Ca^{2+}
H^+ Na^+
NH_4^+
Mg^{2+}
SO_4^{2-}
Cl^-

Organic Soil Fertility for Vegetables and Strawberries
University of California Short Course



(Soil Quality Pty Ltd. 2019. http://soilquality.org.au/factsheets/soil-nitrogen-supply)

Organic Soil Fertility for Vegetables and Strawberries

University of California Short Course

Richard Smith: Dry organic fertilizers

Richard Smith & Joji Muramoto: Liquid organic fertilizers

Mike Cahn: Nitrate in irrigation water

Rammy Colfer: Industry perspective

Joji Muramoto: N management in organic strawberries

Rob Mikkelsen: P & K in organic production

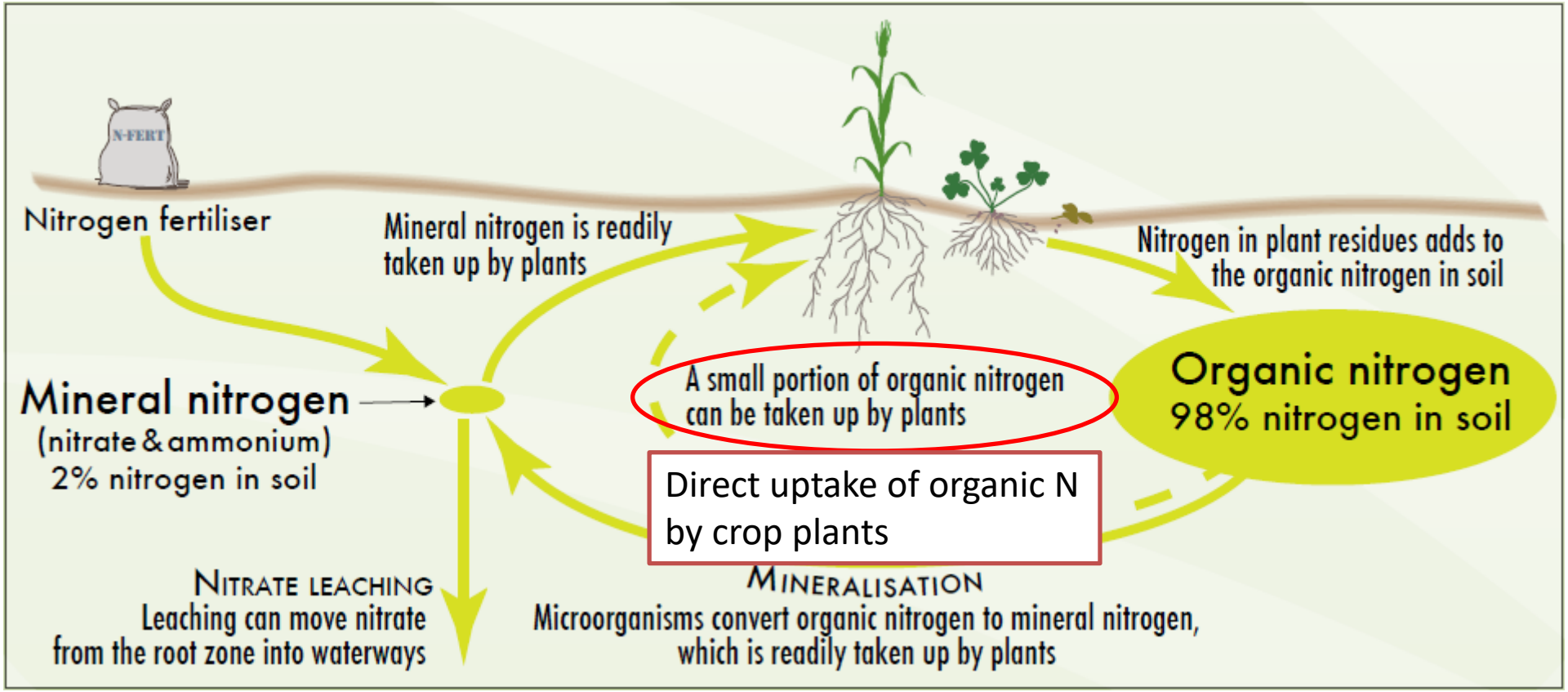
Tim Hartz: Soil and tissue test, N & P management in organic production

Eric Brennan: N from cover crops

Tim Bowles: Roles of soil microbes in plant N & P uptake

Daniel Geisseler: SOM, crop residues and amendment N mineralization

Discussion 4-4:30



(Soil Quality Pty Ltd. 2019. http://soilquality.org.au/factsheets/soil-nitrogen-supply)

PERGAMON

Soil Biology & Biochemistry 32 (2000) 1301–1310

Soil Biology & Biochemistry

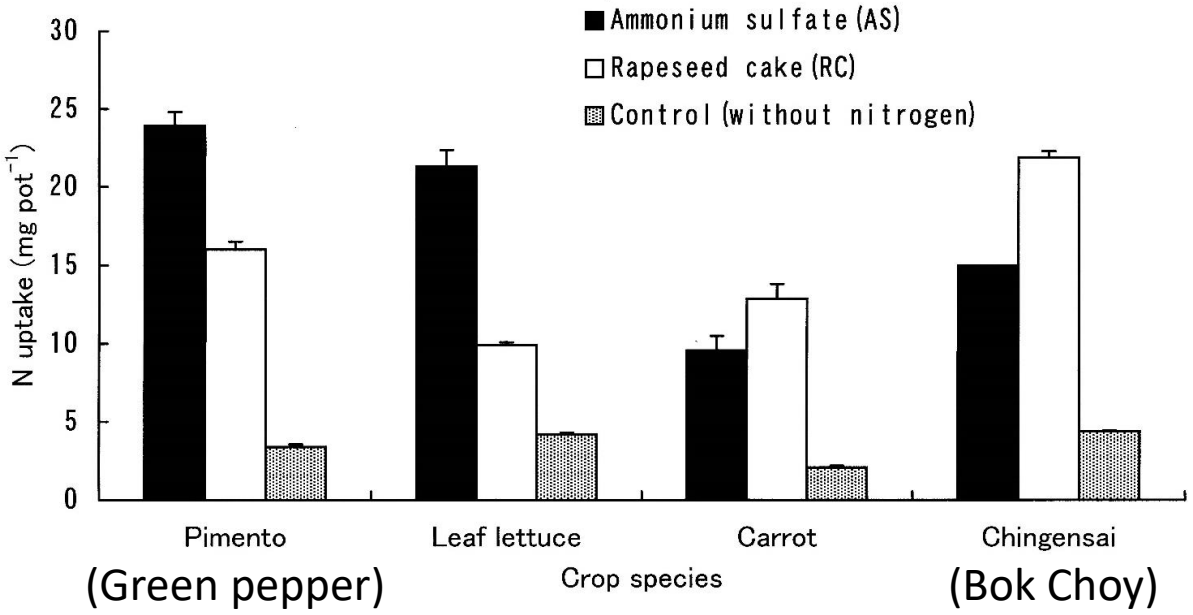
www.elsevier.com/locate/soilbio

Possible direct uptake of organic nitrogen from soil by chingensai (*Brassica campestris* L.) and carrot (*Daucus carota* L.)

Shingo Matsumoto[a,*], Noriharu Ae[b], Makoto Yamagata[c]

[a]*Shimane Agricultural Experiment Station, Izumo 693-0035, Japan*
[b]*National Institute of Agro-Environmental Sciences, Tsukuba 305-8604, Japan*
[c]*Hokkaido National Agricultural Experiment Station, Memuro 082-0071, Japan*

Received 8 April 1999; received in revised form 8 September 1999; accepted 16 February 2000

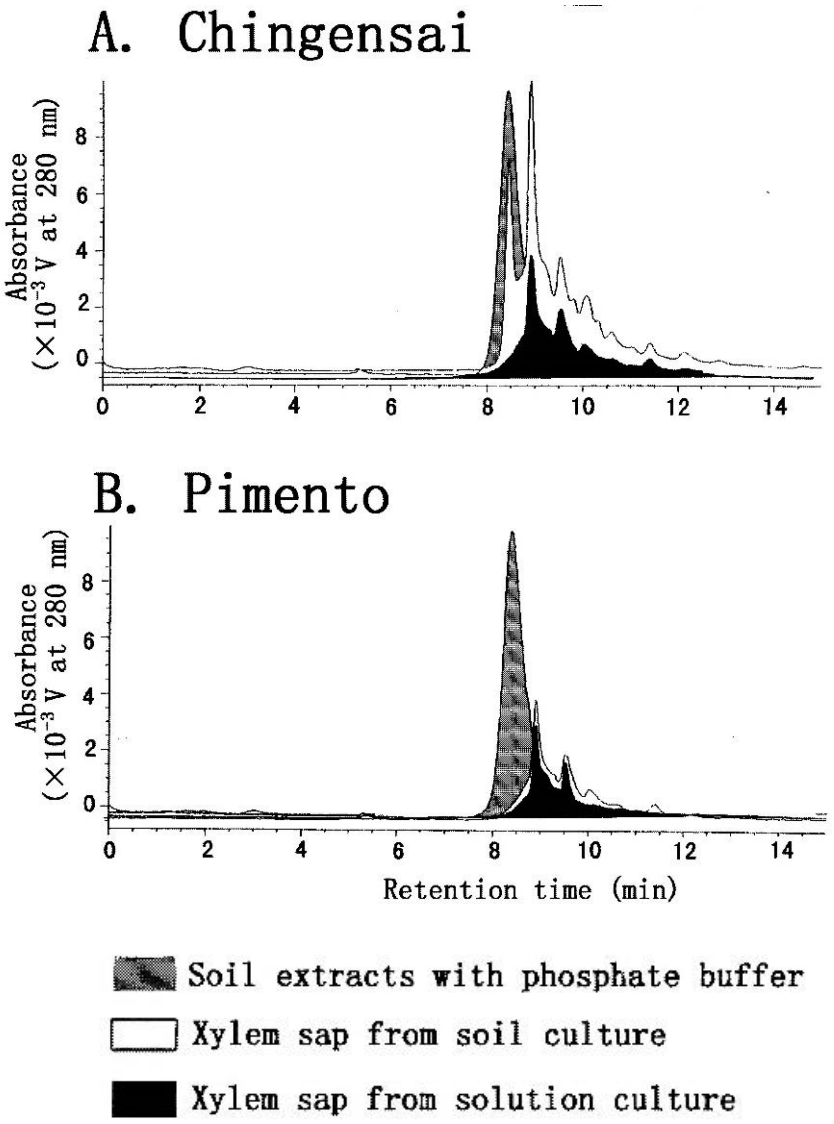


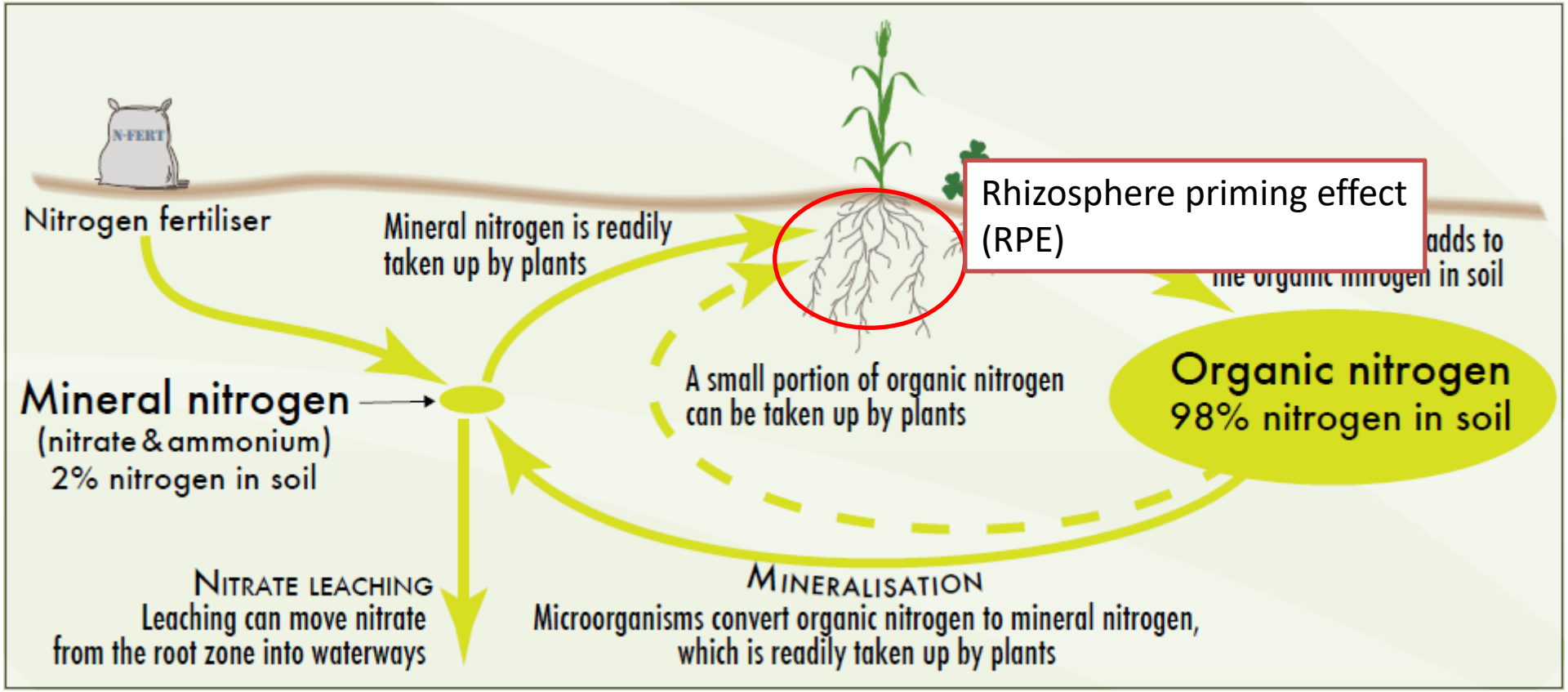
Spinach also showed a similar trend with Chingensai (= Bok Choy)

PEON: phosphate buffer-extractable organic N

- Extract with 1/15 M phosphate buffer
- MW: 8,000-9,000 Da
- Bacterial cell wall absorbed to Fe or Al in soil?
- Found in xylem sap in chingensai and spinach
- Non-mycorrhizal plants; *Amaranthaceae, Brasiccaceae*
- Qualitative evidence only
- Contribution to overall N uptake unknown

(Matsumoto et al., 2000a, 2000b)

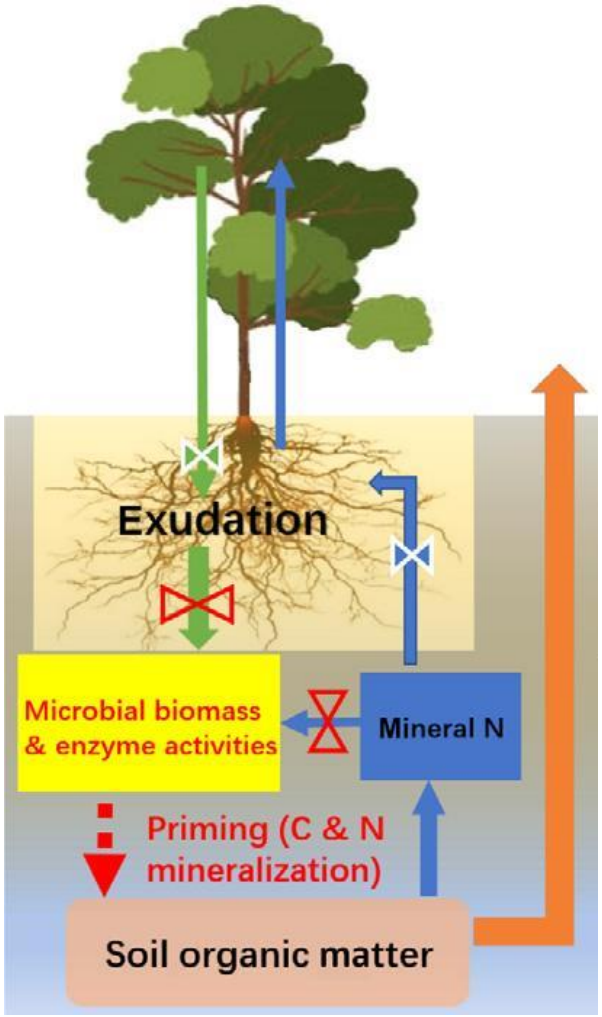




(Soil Quality Pty Ltd. 2019. http://soilquality.org.au/factsheets/soil-nitrogen-supply)

Rhizosphere Priming Effect (RPE)

- The stimulation or suppression of soil organic matter (SOM) decomposition by live roots and associated rhizosphere organisms when compared to SOM decomposition from rootless soils under the same environmental conditions (Cheng et al., 2013)



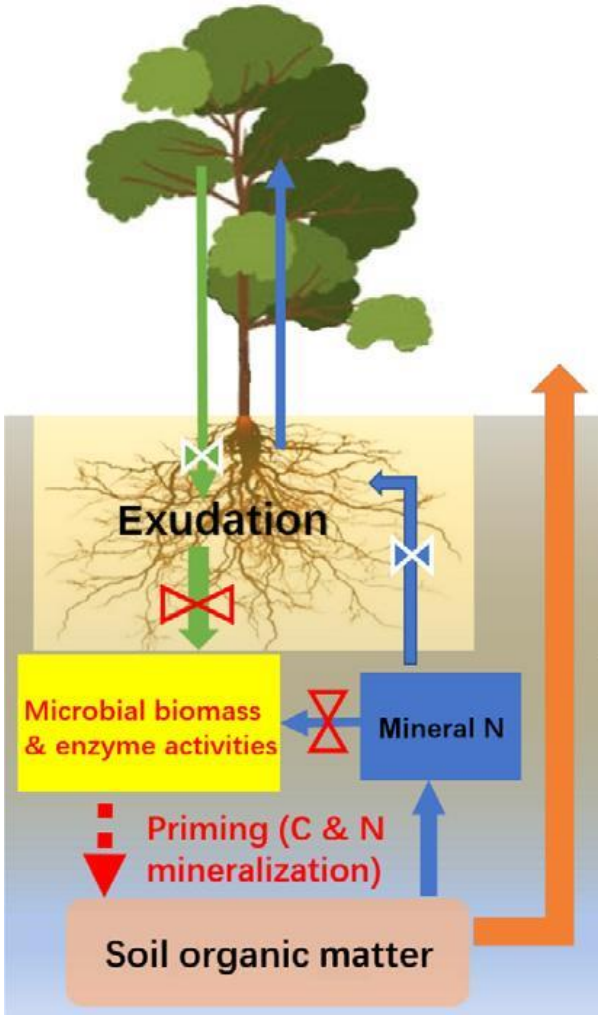
(Yin et al., 2018)

Rhizosphere Priming Effect (RPE)

- Highly variable;
  - For C, -50% to +350%
  - For N, 36-52% (soybean and sunflower) (Zhu et al., 2014)

  depending on climate, plant, and soil variables

- No studies on RPE of vegetable crops and strawberries just yet



(Yin et al., 2018)

References

- Cheng, W. X., Parton, W. J., Gonzalez-Meler, M. A., Phillips, R., Asao, S., McNickle, G. G., Brzostek, E., and Jastrow, J. D. (2014). Synthesis and modeling perspectives of rhizosphere priming. *New Phytologist* **201**, 31-44.
- Matsumoto, S., Ae, N., and Yamagata, M. (2000). Extraction of mineralizable organic nitrogen from soils by a neutral phosphate buffer solution. *Soil Biology & Biochemistry* **32**, 1293-1299.
- Matsumoto, S., Ae, N., and Yamagata, M. (2000). Possible direct uptake of organic nitrogen from soil by chingensai (*Brassica campestris L.*) and carrot (*Daucus carota L.*). *Soil Biology & Biochemistry* **32**, 1301-1310.
- Yin, L. M., Dijkstra, F. A., Wang, P., Zhu, B. A., and Cheng, W. X. (2018). Rhizosphere priming effects on soil carbon and nitrogen dynamics among tree species with and without intraspecific competition. *New Phytologist* **218**, 1036-1048.
- Zhu, B., Gutknecht, J. L. M., Herman, D. J., Keck, D. C., Firestone, M. K., and Cheng, W. X. (2014). Rhizosphere priming effects on soil carbon and nitrogen mineralization. *Soil Biology & Biochemistry* **76**, 183-192.

Organic Soil Fertility for Vegetables and Strawberries
University of California Short Course

Rammy Colfer: Industry perspective