The Role of Nutrients in Pest Management

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Fertilizer Research & Education Program Conference
Modesto, CA
October 27, 2016

Overview

- Background
- Disease pyramid
- Definitions
- Effects of soil conditions on disease
- How elements affect diseases/pests
  - N, P, K, Ca, Mg, Mn, Zn, Si
- References

Background

- “The primary reason to monitor is to improve your ability to make good pest management decisions.”
  - IPM in Practice, 2001 ed.
- Why bother plant nutrition testing?

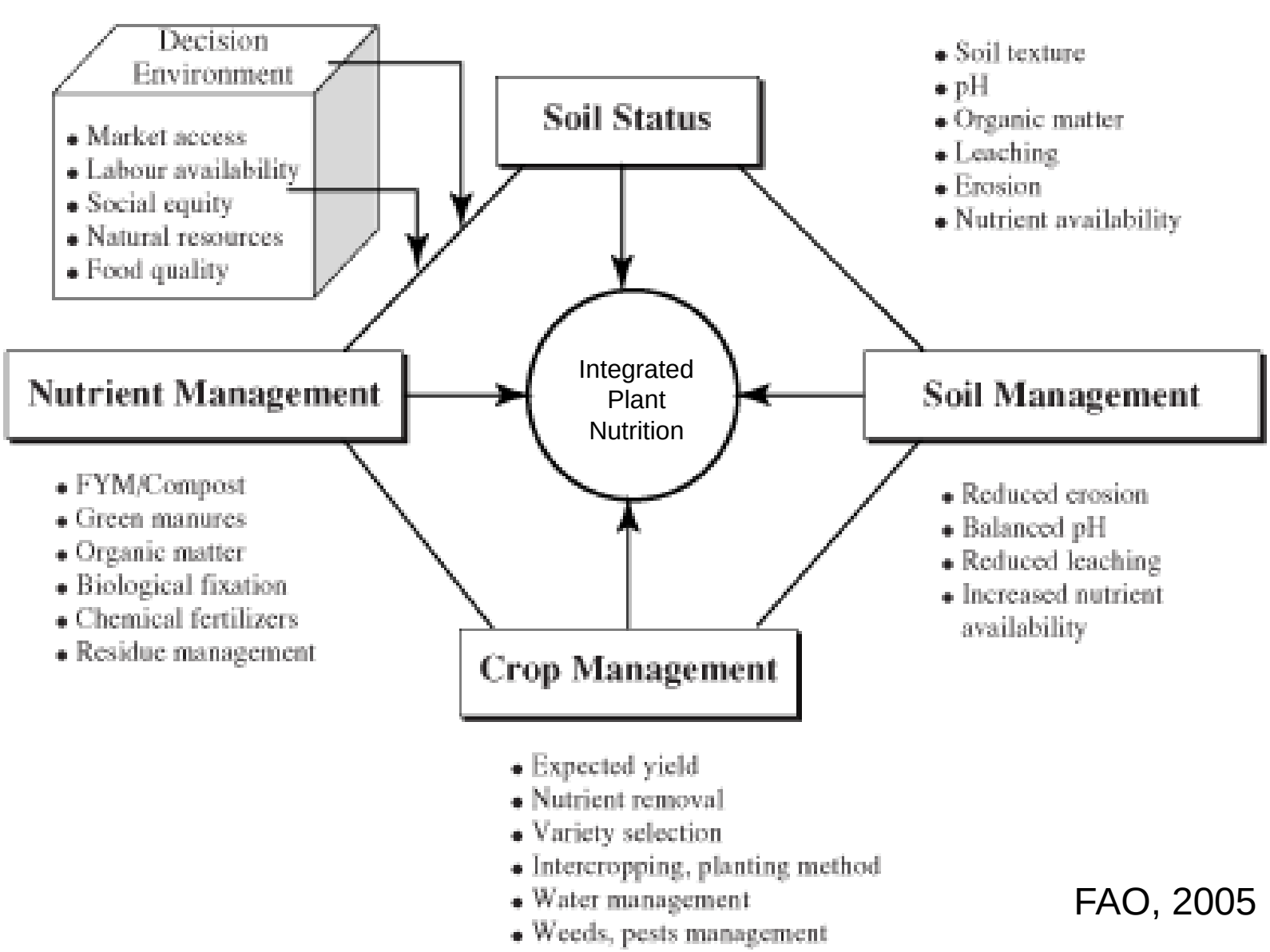
  “Soil tells you what happened.

  Plant tissue tells you what is happening.

  Water tells you what will happen.”

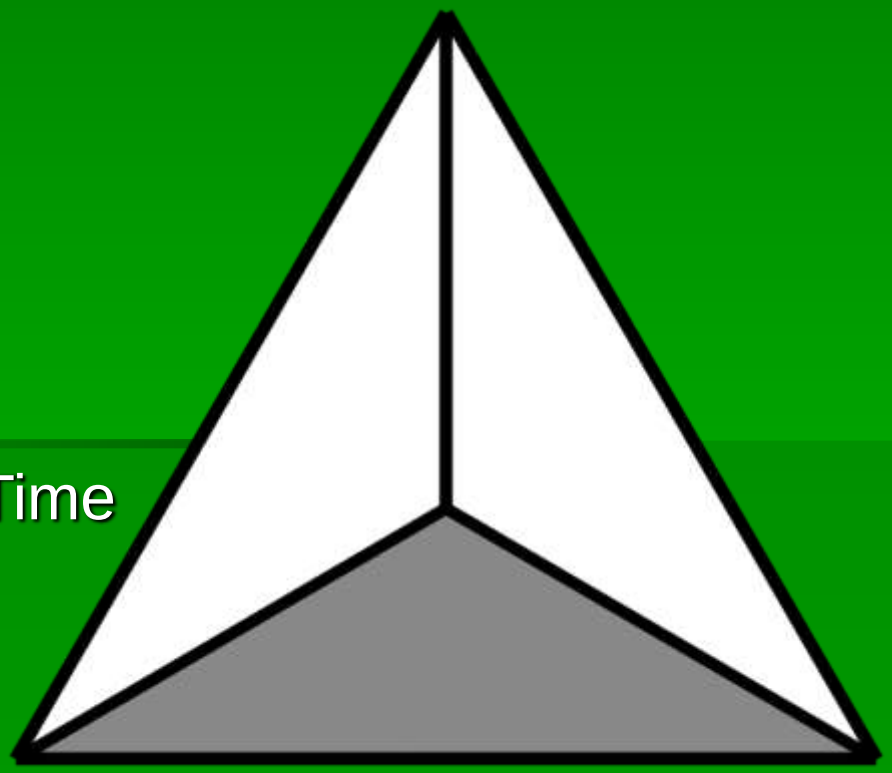
  -E. Simonne
- Determination of yield-limiting factor

Background (cont'd)



FAO, 2005

Disease pyramid vs. IPM vs. Sufficiency Range



Definition of an epidemic

"An epidemic occurs when there is a change in disease intensity in a host population over time and/or space."

-Kranz, 1974

- Incidence: proportion of the plant population being affected (field)
- Severity: proportion of the plant being affected (individual)

Field signatures

- Random hotspots
- Diffuse edges: insects vs. soilborne pathogens
- Uniform: rusts, pollution, drift, nutrition

L.L. Mount, 2012

•Symptoms: damage to the host plant (e.g., yellowing, stunting)

•Signs: visual confirmation of the cause of the damage (e.g., insect, fungus)

The last few terms

- Avirulence: inability of a disease agent to infect a plant with genetic resistance
- Virulence: ability of a pathogen to cause disease
- Resistance: ability of a host plant to exclude/overcome a disease or other damaging factor
- Tolerance: ability of a host plant to endure damaging factor without debilitating injury or crop loss

Effects of soil pH & structure on disease, insects

- Increased incidence & severity of cotton root rot (*Phymatotrichopsis omnivora*) on peach in soils with high $CaCO_3$ content (SW US & northern Mexico) (Cribben, 2013)
- Increased virulence of downy mildews at acid pH
  - clubroot of crucifers (*Plasmodiophora brassicae*) highly virulent at pH 5.7, mildly at 6.2; gone by 7.8 (Webster and Dixon, 1991)

J.C.Clark, 2000

Nitrogen

R.M. Davis, 2009

- New growth, delayed maturity
- Under-fertilization of N can lead to increased early blight (*Alternaria solani*) on potato (MacKenzie, 1981); fusarium wilt (*Fusarium oxysporum*) on melons (Egel and Martyn, 2013)
- Over-fertilization can lead to increased disease susceptibility
  - Fire blight (*Erwinia amylovora*) on apple, pear (Johnson, 2015)
- Over-fertilization can lead to greater disease severity
  - *Rhizoctonia solani* on rice (Datnoff, 1994)

Nitrogen

- Form of nitrogen (ammonium, nitrate) effects severity of disease (Huber and Watson, 1974)
  - Acid-loving soil diseases are more severe when crop is fertilized with ammonium-N (fusarium root rot, clubroot)
  - Take-all of wheat (*Gaeumannomyces graminis*), potato scab prefer nitrate-N

Nitrogen

- Aphids and white flies are attracted to yellow, repulsed by dark green, blue (Smith, 1976; Cohen and Melamed-Madjar, 1978)

D.H. Hall, 2009

Phosphorus

- Reduces severity
  - Take-all (*G. graminis*) of wheat (Brennan, 1989)
  - Potato scab (*Streptomyces scabies*) (Davis et al., 1976)

L.F. Jackson, 2007

Potassium

- Reduces drought stress, frost injury, may affect pathogen establishment (Wang et al., 2013)
- Delays maturity/senescence in some crops, increases vulnerability to facultative pathogens, parasites (Hendrix and Campbell, 1973)
- Decreases disease severity
  - Early blight of tomato (Blachinski et al., 1986))
  - Rice blast (*Magnaporthe grisea*) (Datnoff, 1994)
- High K levels increase severity
  - Southern root knot (*Meloidogyne incognita*) (Marks and Sayre, 1964)
  - White tip of rice (*Aphelenchoides oryzae*) (Datnoff, 1994)

Calcium

- Generally increases disease resistance through plant defense responses (Lecourieux et al., 2006)
  - *Ditylenchus dipsaci* (Sherwood and Husingh, 1970)

Magnesium

- Phytoplasmas & spiroplasmas inhibit Mg uptake (de Oliveiro et al., 2002)
- Decreases disease
  - Fusarium wilt (Huber and Jones, 2012)

C.G. Summers, 2006

Manganese

- Reduced disease
  - Take-all (Bockus and Tisserat, 2005)
- Increased disease
  - *Phytophthora cinnamomi* on avocado (Huber and Wilhelm, 1988)

D. Rosen, 2007

Zinc

- Reduced disease in HLB-infected citrus (Iftikhar et al., 2016)
  - January pruning with vector control & fertilization
  - $ZnSO_4$ + $MnSO_4$ foliar application for under 2 months

Silicon

- Reduces disease (Datnoff, 1994)
  - Sheath blight (*R. solani*) of rice
  - Rice blast (*M. grisea*)

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Thank you!
Questions?

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