Update on Nitrogen Management Field Studies with Strawberries and Leafy Vegetables

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Nitrogen has a major effect on vigor, production and harvest quality of fruits and vegetables.

Historically, rates of application and need for high N utilization efficiency not important because of low cost.

Cheap insurance and ample application considered inexpensive insurance.
Background / Overview

- N considered a contaminant in ground and surface waters
- Spikes in N costs – closely tied to energy cost
- Organic N sources for organic production are always expensive and uncertain.
Situation

• Negatively charged nitrate molecule most abundant in agricultural fields and moves freely with water to manage N need to manage fertilization and water
• Measure 15 ppm soil nitrate N on a dry soil basis = 3 – 5 TIMES that amount in solution – so root zone and effluent concentration is much higher than measure of soil N
• Need to match N application to crop need total and timing of application
Managing Nitrogen Efficiency?

- Optimize N loading at the field end
- Minimize water leaving the root zone
Strawberry Study -2008- 09

Albion Variety

Three Pre plant CR N rates
  0
  65 lb N (350 lb / A 18-4-8)
  130 lb N (700 lb / A 18-4-8)

Weekly Applications of 2.5, 5, 10 lb N

Measures:
  Weekly soil residual nitrate-N
  Seasonal plant growth and N uptake
  Yield

University of California Cooperative Extension
Santa Maria, CA
Conventional Strawberry Trial – 2008-09
Residual Soil Nitrate at different Fertilization

Sample Date

0 lb Pre

Nitrato-N Residual (ppm)

2.5 lb N / Week
5 lb N / week
10 lb N / week
Conventional Strawberry Trial – 2008-09
Residual Soil Nitrate at different Fertilization

68 lb Pre

Sample Date

Residual Soil Nitrate-N (ppm)

2.5 lb N / Week
5 lb N / week
10 lb N / week
Conventional Strawberry Trial – 2008-09
Residual Soil Nitrate at different Fertilization

Sample Date

2.5 lb N / Week
5 lb N / week
10 lb N / week

135 lb N Pre

Residual Soil Nitrate-N (ppm)
Strawberry Nitrogen Accumulation

Some N important
Total Strawberry Yield at Varying Preplant and In-Season N Rates

Total fruit yield to 7/17
Organic Strawberry Study -2008- 09

Albion Variety

Three organic N sources
  True Organic (started with Agrilizer_
  Neptune’s Harvest (started with Nitriboost)
  Phytamin 801

Weekly Applications of 6, 12, 18 lb N

Measures:
  Weekly soil residual nitrate-N
  Seasonal plant growth and N uptake
  Yield
Weekly Residual Soil Nitrate Nitrogen
Manzanita Farms – Santa Maria, 2008-09 Season

Residual Soil Nitrate-N (ppm)

- 6 lbs N/A/wk
- 12 lbs N/A/wk
- 18 lbs N/A/wk

Dates:
- 1/4/05
- 1/19/05
- 2/3/05
- 2/18/05
- 3/5/05
- 3/20/05
- 4/4/05
- 4/19/05
- 5/4/05
- 5/19/05
- 6/3/05
- 6/18/05
- 7/3/05
Total strawberry yield from plots receiving varying types of organic fertilizer as weekly N fertigation
Santa Maria, CA – 2008-09 Season

low soil nitrate suggests problems with N availability
Seasonal Fresh Weight Accumulation by Organic Strawberry Plant and Fruit
Manzanita Farms – Santa Maria, 2008-09 Season
Seasonal Nitrogen Accumulation by Organic Strawberry Plant and Fruit
Manzanita Farms – Santa Maria, 2008-09 Season

[Graph showing seasonal nitrogen accumulation from December 2008 to June 2009, with peaks in May and June.]
Use of soil quick test to reduce N applications

3 treatments

if $\geq 25$ ppm nitrate- N:
1) 0 application
2) $\frac{1}{2}$ normal side dress
3) normal side dress

Preliminary conclusions:
N uptake is very different from strawberry
Can eliminate pre plant
Normal N needed for at least last side-dress
Lettuce N Uptake
Morro Bay, CA - 2009
Nappa Cabbage
Morro Bay, CA - 2009 season

Nitrogen Accumulation (lb N/A)
Match N availability to crop need - strawberries

- Transplanted strawberry N uptake about 4 lb – 10 lb N/acre - first 90 days. – rainy winter period

- During the next 20 weeks of growth, N uptake approaches 70 to 90 percent of seasonal total ~ 130-150 lb N/acre

- N uptake is steady and continuous for the entire period

- Current strawberry fertigation reccs for FL = 0.3 lb – 0.75 lb N/acre/day
Summary

• Many fields have excessive N in top foot and application rates often unrelated to yield.

• Opportunities exist to improve N use efficiency
  - some growers are much more efficient

• Need to match N application to plant uptake

• Water management also plays a role
  - nitrate moves with water
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Additional Information

Vegetable Research and Information Center (VRIC), UC Davis - Educational Modules

http://groups.ucanr.org/nutrientmanagement/index.cfm