Fertigation Chemigation

Jim Schepers (retired)

Center-Pivot Fertigation



Self-Contained Fertigation Unit



Fertigation Components





Anti-Siphon Devices



FLOW

Figure 3. Detail of an anti-siphon device (drawn by Dale Baker)

Chemical Safeguards

• Essential components

back-flow restriction electric inter-lock supply tank over-flow protection flow meter

- Over-application of N if pivot stalls but continues to apply water
- Double-check calibration and periodically verify application rate

Uniformity of Water Application

• Poor water uniformity in water application results in poor uniformity of N application

rotation speed not adjusted for area being watered / pressure changes improper nozzle sizes non-uniform pressures (regulators) canopy interference problems

Irrigation Design Flaws



Irrigation Design Flaws

Nozzle in canopy

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More uniform water distribution - Hopefully



End-gun "OFF"

Uniformity Concerns: (May Turn Into Huge Yield Concerns)





Nozzle Considerations

- Closely spaced nozzles result in greater uniformity (operate under lower pressures)
- Large droplet size is preferred
- Fine particles result in greater evaporation
- Insure adequate overlap of spray patterns
- Check for plugged nozzles
- Need for pressure regulators

Drop-Nozzles



Variable Rate Irrigation

Water Application Efficiency LOSSES

Low-Angle Impact Sprinkler ~15%

Spray Heads

LEPA*

*LEPA – Low Energy Precision Application

2%

8%

N Loss Potential

• Greater losses when:

High pH water (salty)

- High temperatures
- Low humidity
- Windy conditions

High pressures (small particle size)

N Application Rate

- High N concentrations in water can "shock" corn plants
- Might need to fertigate even if soil contains adequate supply of water
- Commonly used N application rates:
 20# N / 1-inch
 30# N / 1.5-inches
- Ammonium Thiosul (12-0-0-26) has some therapeutic value

Example : Soil NO₃-N (silt loam)

Residual Soil N (60 lb / ac-ft)

(3.6 million lb / ac-ft)

50% Porosity

ADD Water





~16.7 lb NO₃-N / million lb soil (ppm)

Field Capacity



60 lb NO₃-N / ac-ft

60 lb NO₃-N in 0.68 million lb water

(226,512 lb / ac-in)

88 ppm NO₃-N in soil water

Need to Fertigate ???

- Imagery can show spatial patterns, but need to be verified as to the cause
- Leaf N concentration decreases as plant matures
- DRIS analysis (tissue testing) can help evaluate other nutrient imbalances
- Consider growth stage and N uptake pattern



Early symptom

Mexico - April, 2008













Landsat



~60-ft resolution

1-ft resolution

August 20, 2005

Seed roduction

2-ft spatial resolution

Color Infrared



sectors and the baller of the sector of the

2.5 ac Grid Sampling

~300-ft resolution 1 point / 2.5 ac



0.5-ac Grid Sampling

150-ft resolution2 points / ac

Yield Monitor

~12-ft resolution 100 points / ac

Aerial Photograph

~1-ft resolution ~40,000 points / ac



Timing of N Applications

- Anticipate growth stages with critical N needs and future requirements
- Late-season N applications are likely to be ineffective
- Cool and wet soils have reduced mineralization
- Warm wet soils can have high denitrification losses



Rows of Kernels











N Form and Problems

- Volatile losses of anhydrous ammonia is higher than UAN (raises pH)
- 32% UAN can "salt-out" under cold conditions
- Anhydrous ammonia will increase pH and cause precipitation of Ca and Mg salts
- Little direct foliar uptake of UAN
- P in DAP stays in surface soil

Plant Response Time

- Measure SPAD meter changes within 3 days
- Visually see canopy changes within a week
- Severe N deficiencies can not be corrected with fertigation
- Modest N stresses at specific growth stages can reduce yield potential



H+



pН

.....

$NH_3 + H_2O = NH_4OH$

OH-



SO₄-2



Some Useful Things to Know

0.228 lb N/acre-inch/ppm nitrate-N

~450 gal/min = 1 acre-inch/hr

~27,300 gal/acre-inch

1 gal/hr x 2.133 = ml/min

Density of **32% UAN** = 11.06 lb/gal 32% UAN contains 3.54 lb N/gal Salts out @ 32° F

Density of **28% UAN** = 10.65 lb/gal 28% UAN contains 3.0 lb N/gal Salts out @ 5° F

Don't Overlook the Freebies in Water

Nitrate Ibs N/acre

(inches) x (ppm) x 0.227



(mm) x (ppm) x 0.01

or



(Na, Ca, Mg)

Irrigation with High Nitrate Water

Fertigation

30 mg/L NO₃-N water

3.0 kg N/ha-cm6.6 lb N/acre-inch

Sample Calculation

 Apply 20 lb N as UAN per acre on 130-ac field with 900 gal/min in 1.0" water application



13.2 gal/hr x hr/60 min x 128 oz/gal = 28.16 oz/min

28.16 oz/min x 29.51 ml/oz = 831 ml/min

Don't Irrigate ???

Have access to high-clearance sprayer

Think about crop sensors



Hannibal, MO - 2008

ch" Strip

6

50 kg/ha preplant

2008 Studies

Six fields \$14-119/acre benefit

<u>2009 Studies</u> 21 fields Averaged \$23/acre benefit





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