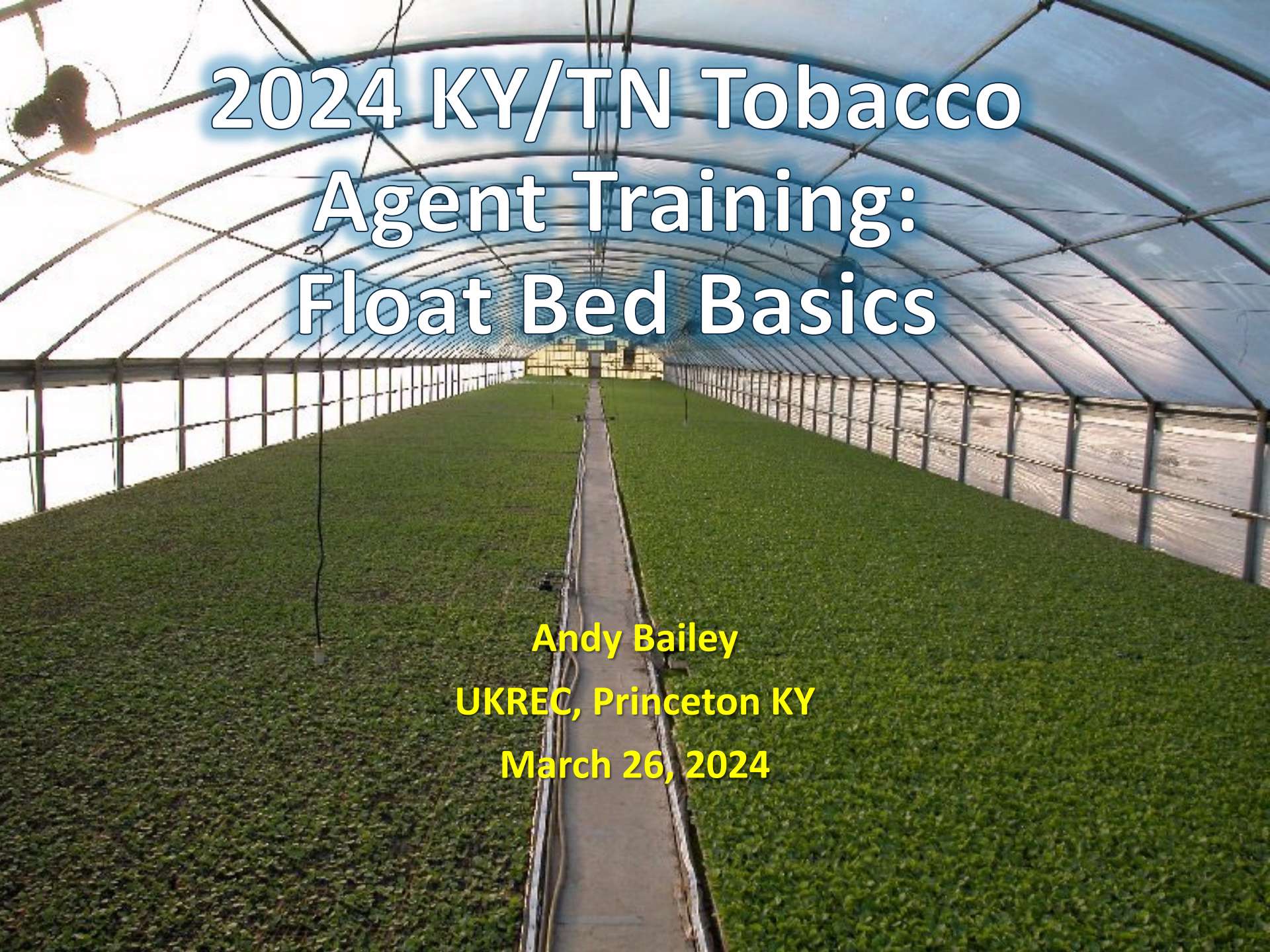

2024 KY/TN Tobacco Agent Training: Float Bed Basics

Andy Bailey
UKREC, Princeton KY

March 26, 2024

Tobacco Transplant Production: Water Quality

Andy Bailey

Univ. of KY

UKREC, Princeton

Water Quality in Float Beds

- Water from municipal water sources should be suitable for use in float beds
- Water from private wells may not be – should get tested
- UK Regulatory Services – Irrigation Water Test (form W)

Martin-Gatton College of Agriculture, Food and Environment | Division of **Regulatory Services**

Submit samples through your county Extension office.

County Code: ☐☐☐

Irrigation Water Test

Your report will show pH, Conductivity, Alkalinity, Nitrate Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Zinc, Copper, Iron, Manganese, Boron and Sodium.

Name _____ Email _____

Address _____

City _____ State _____ Zip Code _____ Phone: _____

Owner Sample ID _____ Date Sampled: _____

TYPE OF SAMPLE (Check One)

Irrigation Water

- ☐ Well
- ☐ Pond
- ☐ Municipal system
- ☐ Other (specify)

Nutrient Solution

- ☐ Fertilizer
  - Type (specify)
  - Rate (specify)
- ☐ Epson Salts
- ☐ Gypsum
- ☐ Acid
  - Type (specify)
  - Rate (specify)

IRRIGATION METHOD (Check One)

☐ Overhead ☐ Trickle or low-pressure emitters ☐ Sub (Float, Flood)

TYPE OF CROP (check where applicable)

Vegetable	**Ornamental**	**Tobacco**	**Other** (specify)
☐ Greenhouse	☐ Container	☐ Direct seed	
☐ Field	☐ Field	☐ Plug and transfer	

ADDITIONAL INFORMATION

Extension office use: Report sent:

Date Received: Received by: Date Entered: Date Paid:

Lab use:

Date Received: Received by: Lab #(s) : Billing Code: v2024-1

Testing also available in TN through A&L Labs, Memphis A70 Irrigation Water Test

Water Quality Guidelines for Tobacco Float Systems (AGR-164)

Table 1. *Water quality parameters to be measured by the University of Kentucky and desirable ranges for these parameters.*

Parameter (units)	Desirable Range
pH	6.0 — 7.5
Conductivity (mmho/cm)	0.0 — 0.75
Alkalinity (ppm)	50 — 100
Nitrate-Nitrogen (ppm)	0.0 — 5.0
Phosphorus (ppm)	0.0 — 5.0
Potassium (ppm)	0.0 — 5.0
Calcium (ppm)	40 — 100
Magnesium (ppm)	15 — 50
Zinc (ppm)	0.0 — 2.0
Copper (ppm)	0.0 — 2.0
Iron (ppm)	0.0 — 2.0
Manganese (ppm)	0.0 — 2.0

Table 2. *Recommendations for tobacco float bed water with alkalinity levels between 100 and 200 ppm CCE.*

Alkalinity (ppm CCE)	Calcium level (ppm)	Recommended Action
125	above 38	None
	below 38	Use acidifying fertilizer
150	above 45	None
	below 45	Use acidifying fertilizer
175	above 53	Use acidifying fertilizer
	below 53	Acidify with acid to 100 ppm CCE
200	above 60	Use acidifying fertilizer
	below 60	Acidify with acid to 100 ppm CCE

- Water alkalinity: capacity of water to neutralize acid or resist lowering of pH.

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Potassium (ppm)	0.0 — 5.0
Calcium (ppm)	40 — 100
Magnesium (ppm)	15 — 50
Zinc (ppm)	0.0 — 2.0
Copper (ppm)	0.0 — 2.0
Iron (ppm)	0.0 — 2.0
Manganese (ppm)	0.0 — 2.0

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	below 53	Acidify with acid to 100 ppm CCE
200	above 60	Use acidifying fertilizer
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- Alkalinity <50 means water has less capacity to buffer against pH decrease, but is okay because recommended fertilizers are non acid-forming (nitrate).

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Calcium (ppm)	40 — 100
Magnesium (ppm)	15 — 50
Zinc (ppm)	0.0 — 2.0
Copper (ppm)	0.0 — 2.0
Iron (ppm)	0.0 — 2.0
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- Alkalinity >100 is common with high pH well water (>7.5), and high alkalinity will keep pH above acceptable levels. Some nutrients will be less available and media may accumulate toxic ammonia.

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200	above 60	Use acidifying fertilizer
	below 60	Acidify with acid to 100 ppm CCE

- Calcium can control some alkalinity, but alkalinity >175 and calcium <50 will need to be corrected with addition of acid to lower pH and alkalinity.

Correcting High Alkalinity Water with Acid

- Virgin battery acid (35% sulfuric acid) = 9.19 N
- Formula:

  $$\frac{\text{ppm CCE alkalinity} * 2.56}{\text{Normality of acid (9.19 for 35\% sulfuric acid)}} = \text{ounces acid per 1000 gal water}$$

  Example: well water sample has alkalinity of 175 ppm and calcium is 45 ppm.

  $$\frac{175 * 2.56}{9.19} = 49 \text{ oz battery acid per 1000 gallons water}$$

- As an alternative to battery acid, high concentrate (30%) vinegar (acetic acid) can be used. Will probably take about twice as much high concentrate vinegar as battery acid.

Symptoms of High Alkalinity Water

Tobacco Transplant Production: Float Bed Fertilizers

Andy Bailey

Univ. of KY

UKREC, Princeton

Float Bed Fertilizers

- Water soluble
- 2-1-2 or 3-1-3 ratio of N-P-K
  - Should have 2 to 3 times more N and K than P

- Nitrogen Source is critical
  - Float bed fertilizers should have at least **60% nitrate-N**
  - Avoid high urea-N content

Nitrogen Sources in Float Bed Fertilizers

- Nitrate-N (NO_3-N):
  - Immediately available, preferred N source in float systems. At least **60%** of float bed nitrogen should be in the nitrate form.
- Ammonium-N (NH_4-N):
  - Is not toxic to float plants, but is taken up more slowly and so plants grow slower
- Urea-N:
  - Urea-N is converted to other forms of N in water and in the soilless media that are toxic to tobacco float plants.

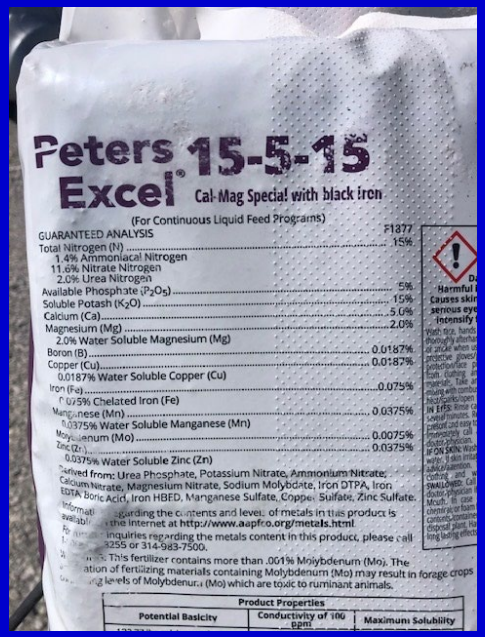
Fertilization in the float system

- Limited growth from urea-based fertilizer source

Nitrate-based Urea-based

Common Recommended Fertilizers For Float Beds

15-5-15 Cal-Mag



Cal-Mag Special
G99145

Guaranteed analysis

Total Nitrogen (N)	15%
1.1% Ammoniacal Nitrogen	
11.8% Nitrate Nitrogen	
2.1% Urea Nitrogen	
Available Phosphate (P_2O_5)	5%
Soluble Potash (K_2O)	15%
Calcium (Ca)	5.0%
Magnesium (Mg)	2.0%
2.0% Water Soluble Magnesium (Mg)	
Boron (B)	0.0187%
Copper (Cu)	0.0187%
0.0187% Water Soluble Copper (Cu)	
Iron (Fe)	0.075%
0.075% Chelated Iron (Fe)	
Manganese (Mn)	0.0375%
0.0375% Water Soluble Manganese (Mn)	
Molybdenum (Mo)	0.0075%
Zinc (Zn)	0.0375%
0.0375% Water Soluble Zinc (Zn)	

Derived from: Ammonium Nitrate, Potassium Nitrate, Calcium Nitrate, Magnesium Nitrate, Urea Phosphate, Boric Acid, Copper Sulfate, Iron HBED, Manganese Sulfate, Ammonium Molybdate, Zinc Sulfate

- 1.4% ammonium N
- 11.6% nitrate N
- 2% urea N
- *77% of total N is Nitrate-N*

Conductivity = 0.56 mS/cm

Common Recommended Fertilizers For Float Beds

20-10-20

20-10-20
General Purpose
G99300

Guaranteed analysis

Total Nitrogen (N)	20%
8.0% Ammoniacal Nitrogen	
12.0% Nitrate Nitrogen	
Available Phosphate (P_2O_5)	10%
Soluble Potash (K_2O)	20%
Magnesium (Mg)	0.15%
0.15% Water Soluble Magnesium (Mg)	
Boron (B)	0.0125%
Copper (Cu)	0.0125%
0.0125% Chelated Copper (Cu)	
Iron (Fe)	0.05%
0.05% Chelated Iron (Fe)	
Manganese (Mn)	0.025%
0.025% Chelated Manganese (Mn)	
Molybdenum (Mo)	0.005%
Zinc (Zn)	0.025%
0.025% Chelated Zinc (Zn)	

Derived from: Ammonium Nitrate, Potassium Nitrate, Potassium Phosphate, Magnesium Sulfate, Boric Acid, Copper EDTA, Iron EDTA, Manganese EDTA, Ammonium Molybdate, Zinc EDTA

Mix ratios (non-injector)

Fertilizer +	Water (gallons) =	Approx. N (ppm)
1 tsp. (level)	1	305
1 tbsp. (level)	2	457
1 cup (level)	25	585

Product properties

Potential acidity	404 lbs. calcium carbonate equivalent per ton
Conductivity (100 ppm N)	0.62 mmhos/cm.
Maximum solubility	3.5 lbs./gal.

Conductivity = 0.62 mS/cm

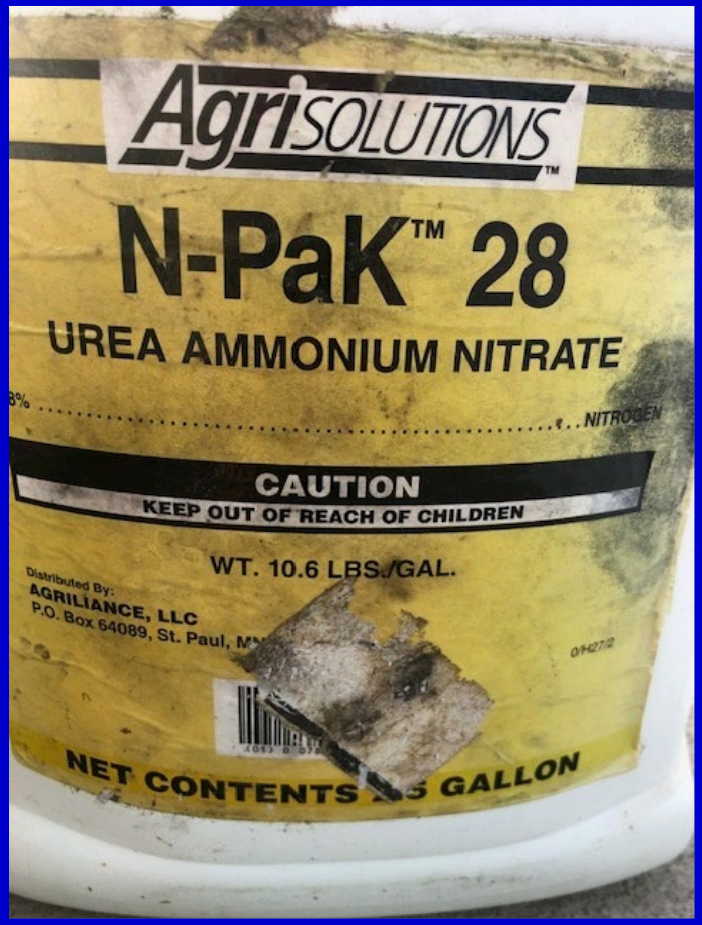
- 8% ammonium-N
- 12% nitrate-N
- 0% urea-N
- *60% of total N is nitrate-N*

Soluble Fertilizers NOT suitable for float beds

- 24-8-16
  - 3.5% ammonium N
  - 20.5% urea N
  - 0% nitrate N

- *85% urea-N, no nitrate-N*

Fertilizers NOT Suitable for Float Beds

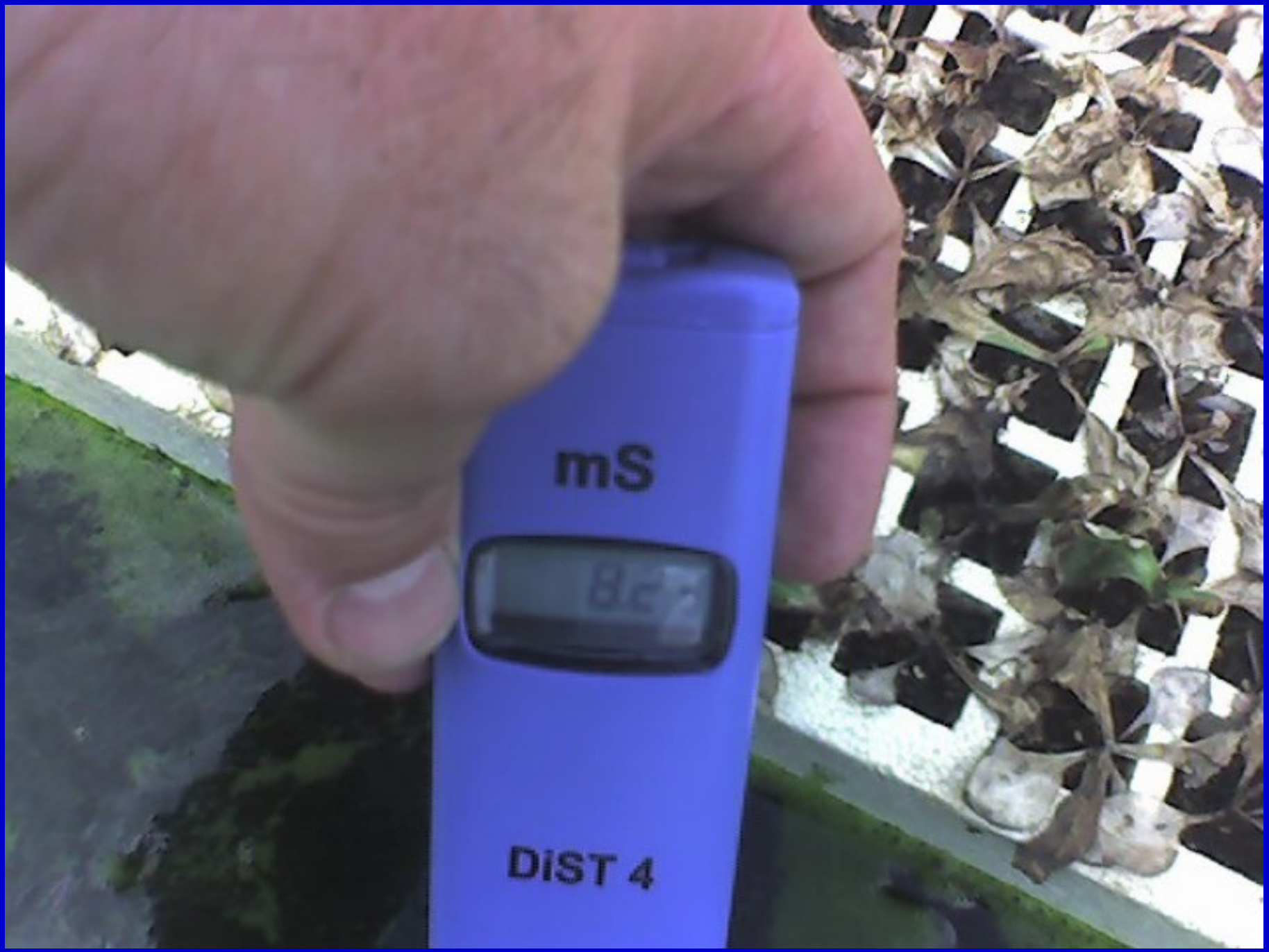


- UAN = Urea Ammonium Nitrate
- **28-0-0** or 32-0-0
- 13.8% ammonium nitrate
  - 50/50 ammonium N/nitrate N
  - 6.9% ammonium-N
  - 6.9% nitrate-N
- 14.2% Urea-N

- 25% nitrate-N
- 25% ammonium-N
- 50% Urea-N

Fertility Problem

- **Water contaminated with UAN solution**
- Using water from farm supply store to fill beds
- Nurse tanks/hoses used for sidedressing wheat then used to fill float beds
- May be low UAN levels, but still toxic to young transplants. Usually have to just start over with clean water.
- **Recommendation:** use on-site water, even if it takes longer to fill the beds.


mS
DIST 4

Micronutrients are needed in Float Beds

- Micronutrients needed:
  - Boron (B)
  - Copper (Cu)
  - Iron (Fe)
  - Manganese (Mn)
  - Molybdenum (Mo)
  - Zinc (Zn)
- Recommended float bed fertilizers will contain adequate amounts of these

Epson Salts in Float Beds

- Magnesium Sulfate ($MgSO_4$)
- Not needed unless water sample suggests need for supplemental magnesium.
- Will provide an artificial short-term ‘greening’ effect.
  - Pale plants from acidic water conditions
  - Low nitrogen levels in water
- Can’t use DiST 4 meter for N monitoring after epsom salt application

Monitoring N levels in Float Beds

- EC meters – measures conductivity (DiST 4) in mS/cm – **recommended**

- TDS meters – measures total dissolved solids (DiST 1, others) in ppm

Float Bed Fertility

- ACCURATELY CALCULATE WATER VOLUME
- ACCURATELY WEIGH FERTILIZER
- GET EVENLY DISTRIBUTED IN FLOAT BED
  - Branching PVC manifold system, submersible pump

Water meter

- Calculating water volume: simple formula assuming bed is full of trays:

# of Trays X depth of water in inches X 1.64 = gallons water in bed

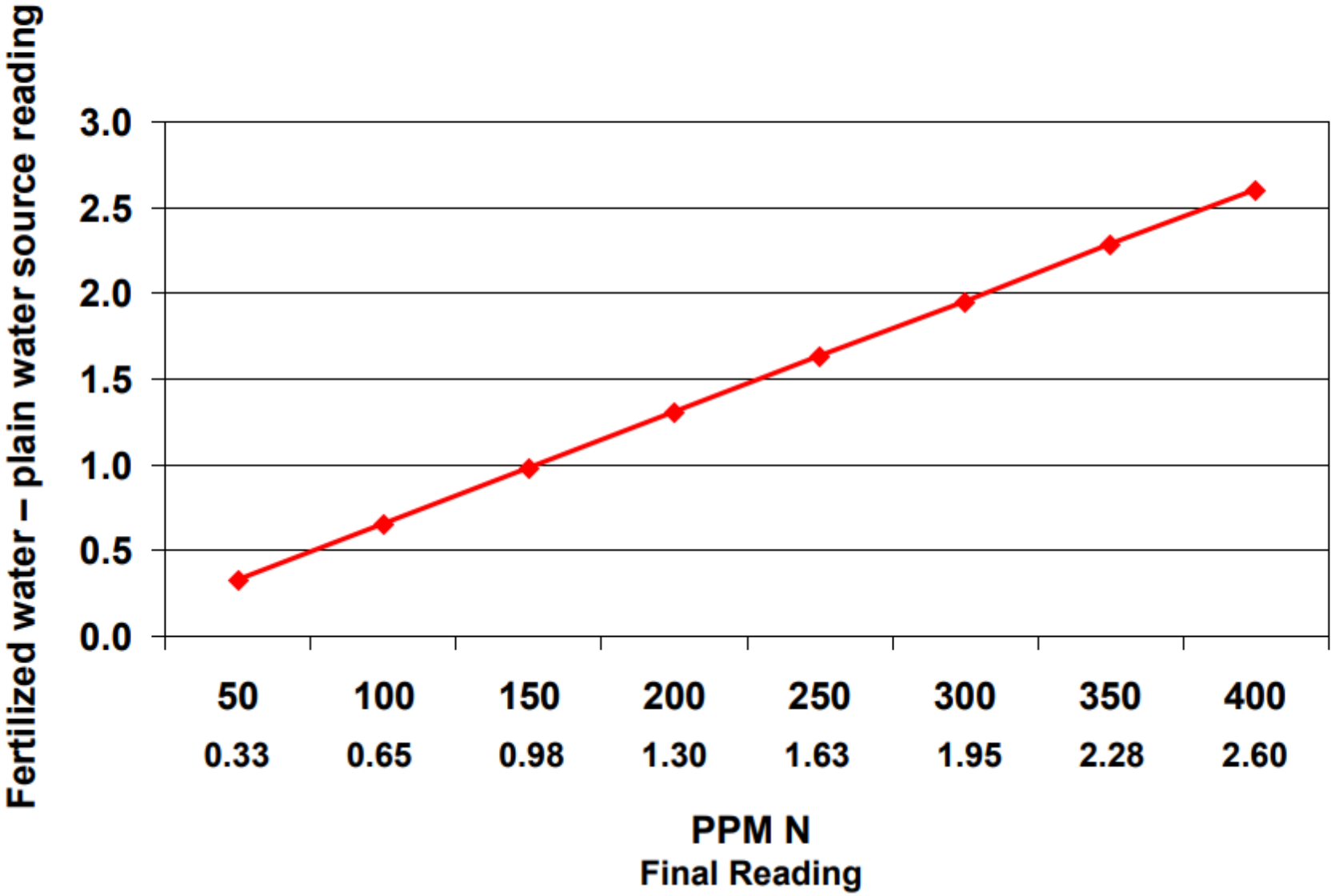
Other method = Length of bed (ft.) X width of bed (ft.) X Depth of water (ft.) = ft^3 water X 7.48 gallons/ft^3 = gallons water in bed

Most accurate water volume = water meter

Float Bed Fertility

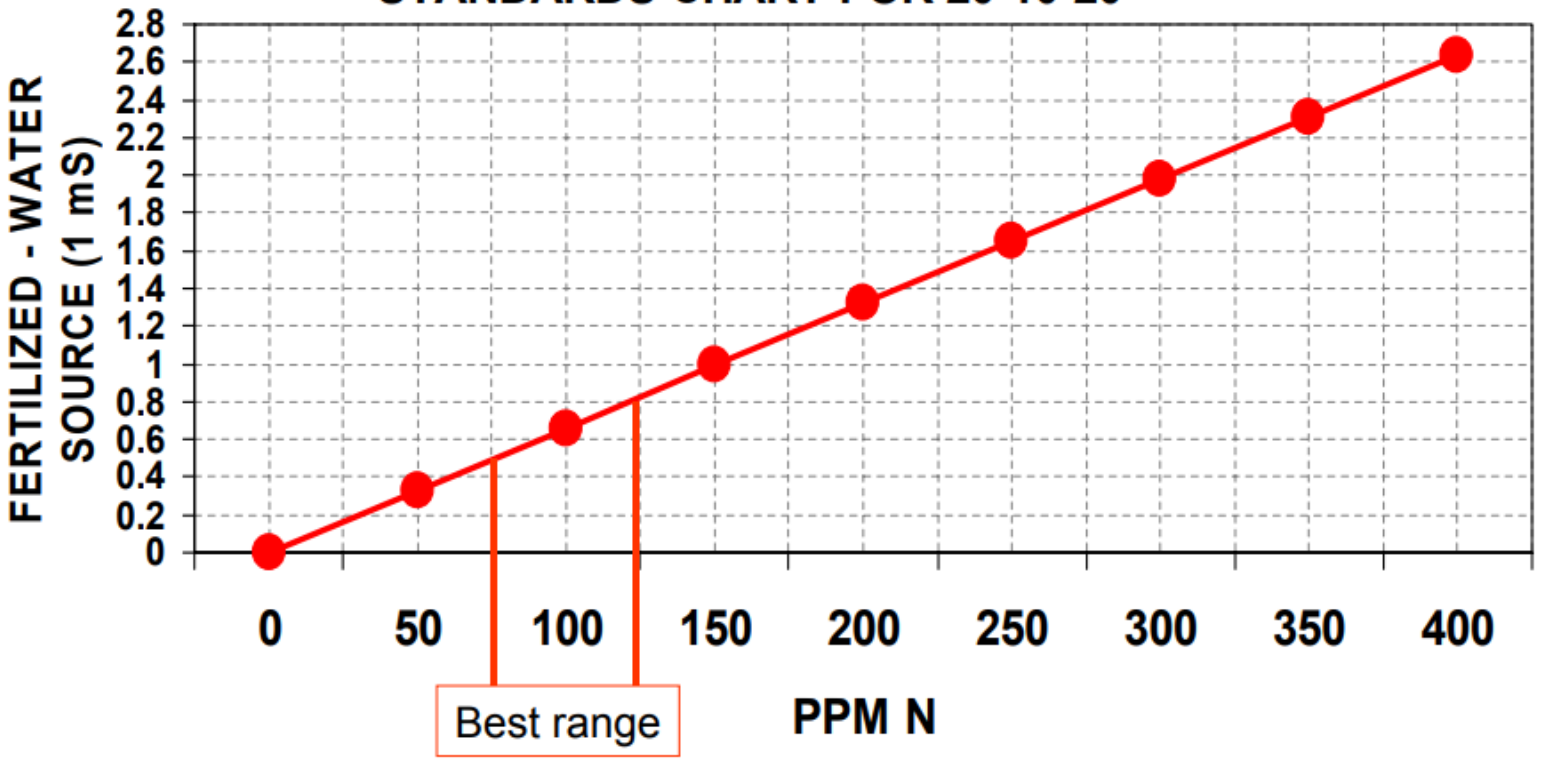
- Water volume
- Tray # X depth in inches X 1.64
- Example: 759 trays * 4.5 in. deep * 1.64 = 5600gal
- Fertilization
- Nitrogen
  - Amount
    - 100 ppm ideal
    - 4.2 lbs 20-10-20/1000 gal X 5.6 (5600 gal) = 23.5 lbs
  - Calculations
    - 20-10-20 to get 100 ppm N
    - Water = 8.34 lb/gal
    - 8.34 X 1000 gal = 8340 lbs
    - 100 ppm = 1/10000 or 0.834 lb / 1000 gal
    - 20-10-20 is 20% N. 0.834/20% or .834/.2 = 4.17 or 4.2 lb/1000 gal
    - If 15-5-15 - .834/.15 = 5.56 lbs lbs/1000 gal

Standards Chart for 15-5-15 (Cal Mag) mS (newer Dist 4 meters)



CONDUCTIVITY READINGS

STANDARDS CHART FOR 20-10-20



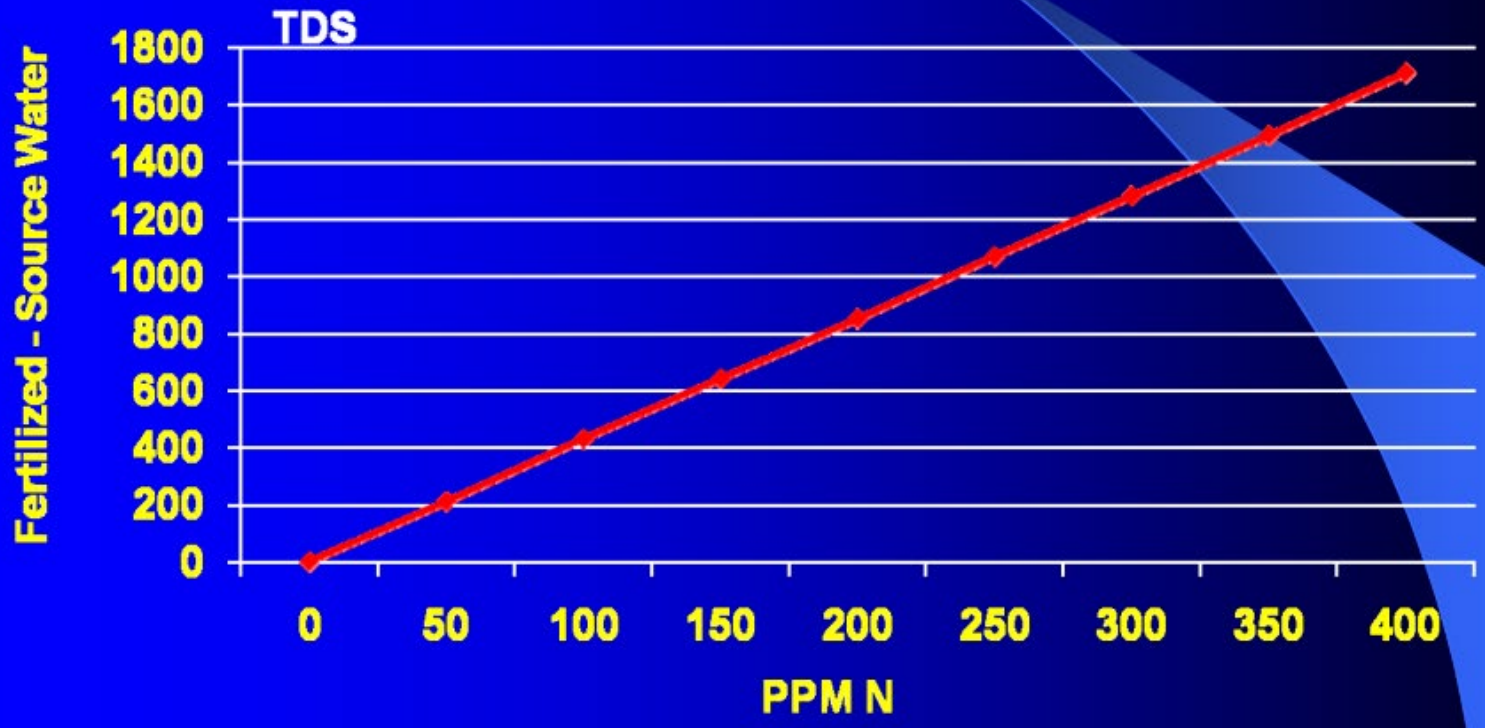
1. Take water source reading (plain water)
2. Take fertilized water reading
3. Subtract water source reading from fertilized

   Example: If plain tap water =.4 & fertilized water = 1.4

   1.4 - .4 = 1 the ppm N corresponding to 1 is 150

CONDUCTIVITY READINGS

STANDARDS CHART FOR 20-10-20
ppm TDS (DiST 1 meters)



1. TAKE WATER SOURCE READING (PLAIN WATER) 2. TAKE FERTILIZED WATER READING
3. SUBTRACT WATER SOURCE FROM FERTILIZED
EXAMPLE: IF PLAIN WATER = 400 & FERTILIZED WATER = 1041, 1041-400=641, PPM N = 150

Using EC and TDS meters

- Conductivity meters are a good tool for monitoring float beds, but not essential to production
- Use for monitoring N status as plants take up N, water evaporates, and N is diluted by adding water.
  - Helps us estimate how much fertilizer to "add back" after initial application
- Meters should not be used as a tool for making the initial fertilizer application.
- If we correctly calculate the water volume and correctly weigh the fertilizer and apply it uniformly in the bed, it will be 100 ppm N.

Adding Back Fertilizer - Example

- You add 5.56 lb 15-5-15 per 1000 gallons water
- Plain water reading is 0.35 on DiST 4 meter
- Fertilized water reading the next day is 1.0 on DiST 4
  - 1.0 fertilized water – 0.35 plain water = 0.65 = 100 ppm N

- 2 weeks later the DiST 4 reading has dropped to 0.80
  - 0.80 – 0.35 = 0.45 = about 75 ppm
  - Add back 30% of full rate (5.56 x 0.30) = 1.7 lbs/1000 gal to get back to 100 ppm

Tobacco Transplant Production: Media and Trays

Andy Bailey

Univ. of KY

UKREC, Princeton

Soilless Media for Float Beds

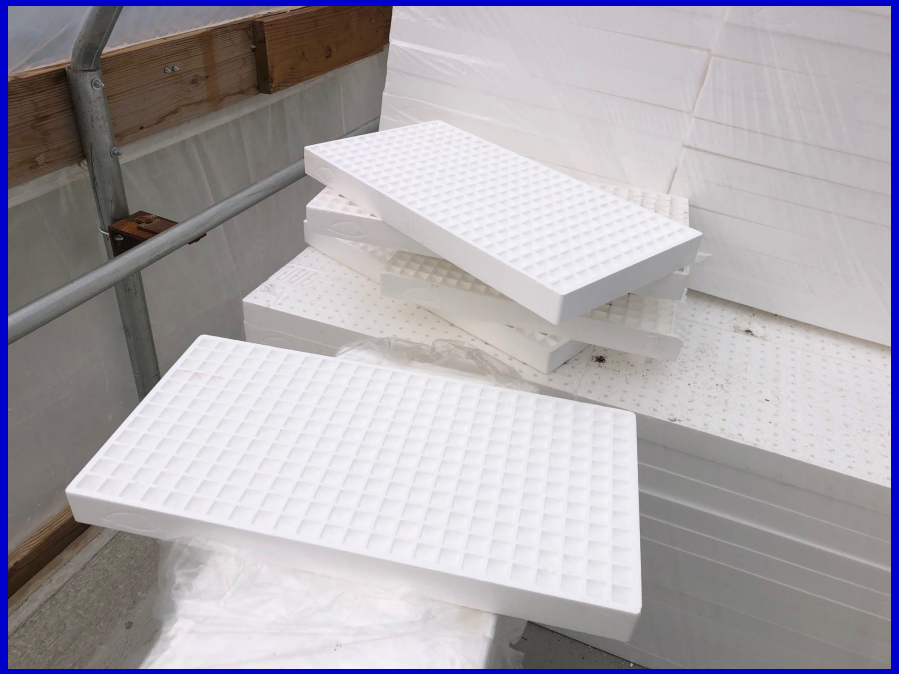
Poor Wicking Media

Wicking = movement of water to top of tray after floating.

- Trays with good media should begin wicking within minutes after floating
- May wick faster on cloudy day
- Media contains wicking agent to allow absorption into hydrophobic peat
- Year-old media may no longer have enough wicking agent
- Fixes:
  - 1 oz nonionic surfactant added to each bag, mix thoroughly
  - 1 to 2 quarts water added to each bag, mix thoroughly
  - For minor wicking problems, push down trays or mist overhead
- Float a few trays the day before seeding to check wicking

Trays

- Expanded polystyrene (EPS) – Styrofoam
- Disposable or reusable
- Disposable: 2-inch thick, low density
- Reusable: 2-½ inch thick, higher density
  - Sterilize with 10% bleach or steam
- No good way to dispose of except landfill



Old Trays vs. New Trays

Tobacco Transplant Production: Greenhouse Climate Control

Andy Bailey

Univ. of KY

UKREC, Princeton

Temperature Control

Temperature: 72 F (70 to 75 F)

- Acceptable range: 60 F to 90 F
- Can drop to 55 F after 4-leaf stage
- Cold Injury:
  - < 60 F for first 3 weeks
  - < 50 F after 4 weeks or 4-leaf stage
- Quick drops in temperature (85 F to 55 F)
- Heat Injury:
- > 95 F for several hours
- – Sporadic germination, uneven growth

Thermostats / Thermometers

- Locate near plant level
- Mount to swing out of way of clipping system
- Max / Min thermometer
  - Daily maximum/mininum temperature
  - < $50
  - Records Max/Min for 6 days

Cold Injury

- Leaf constriction
- Can range from mild to severe
- Damage to terminal bud is key symptom of long-term damage.

Chill Injury

- Most common form of cold injury
- Leaf constriction
- Whitening of midvein
- Much more common in burley than dark
- Terramaster injury can increase cold injury symptoms

Vented Heaters

Suspended inside greenhouse, vented to outside

External Heaters

- Mounted outside greenhouse to blow warm air inside and vents directly outside
- Most common type

Unvented Heater Problems

Suspended or portable

Sulfur Dioxide Injury

*Most likely to occur during prolonged cool, cloudy weather when heater is running continuously and greenhouse closed.

Heat Injury

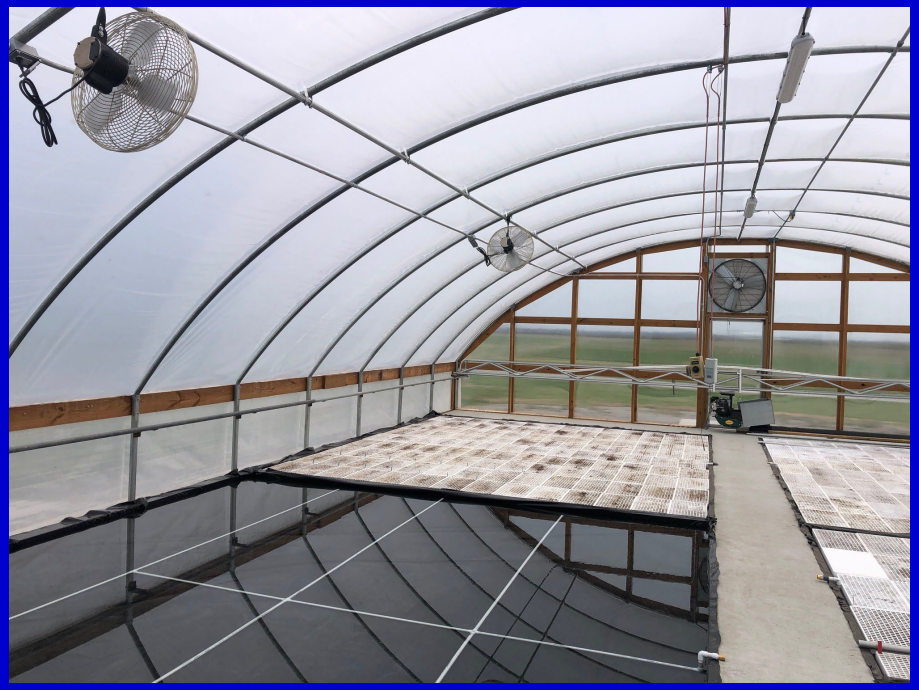
- Temperatures > 95 F for several hours:
- Symptoms:
  - Sporadic germination
  - Sporadic growth rate
  - Water-soaked, translucent appearance
- Increased soluble salts injury may accompany


Heat Injury

Ventilation

- Curtains:
  - 4 to 5 ft. tall down length
  - Automated or manual
  - Should open from top down to keep cold air off plants

Cooling Fan and Louver Circulating Fans



Tobacco Transplant Production: Seeding

Andy Bailey

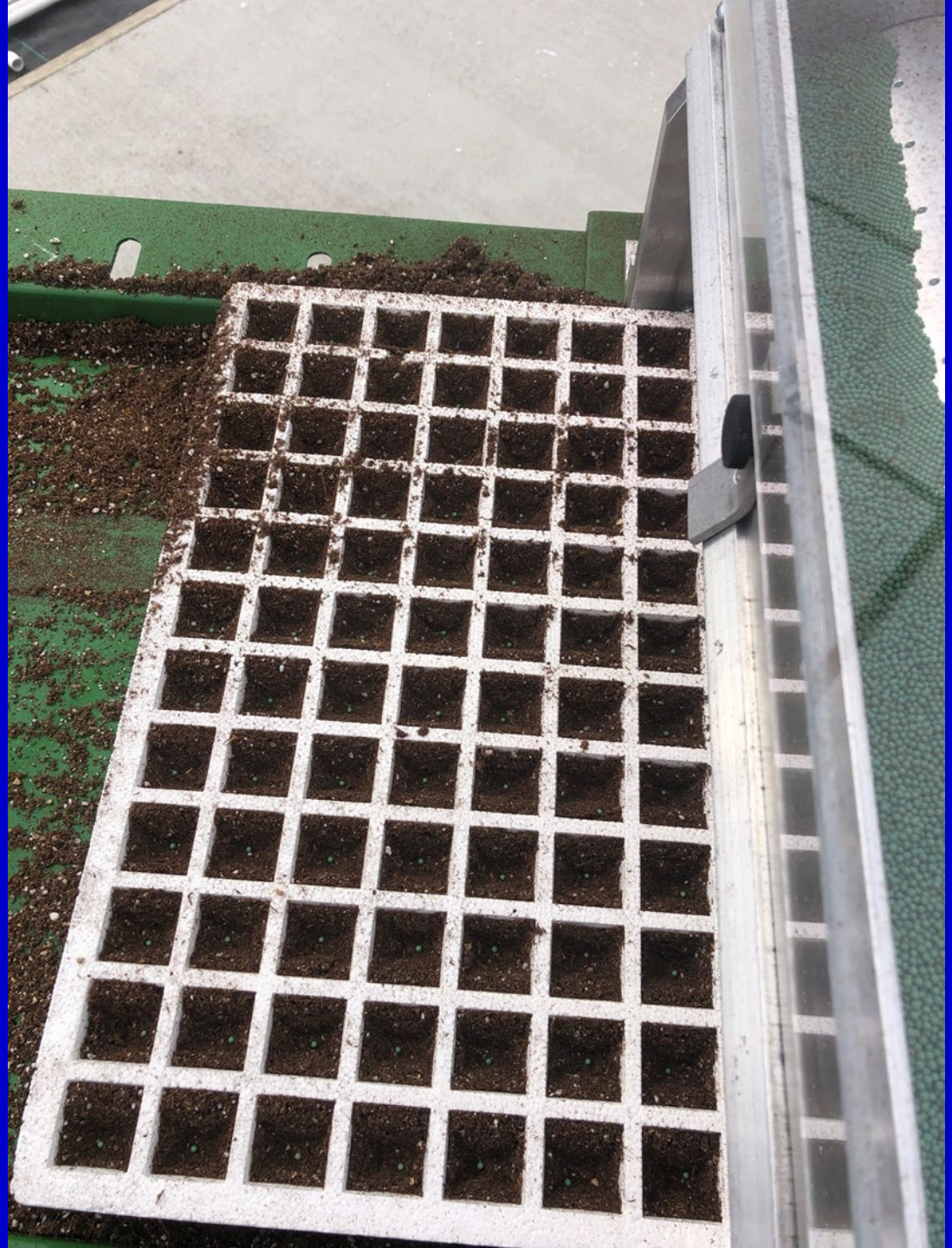
Univ. of KY

UKREC, Princeton

Automated Seeders

- Tray conveyer
- Media loader
- Brush/packer
- Rolling dibbler
- Drum seeder

Automated Seeders



Tobacco Transplant Production: Clipping

Andy Bailey

Univ. of KY

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Clipping Plants

Start early
- 1.5 – 2 in. height
- Take off 0.25 to 0.5 in.
- At least weekly

Reduce risk of disease spread
- Slow blade speed
- Catch clippings
- Wash and sanitize after each use (10% bleach solution)

- > air and light penetration
- > uniformity

Tobacco Transplant Production: Float Bed Diseases

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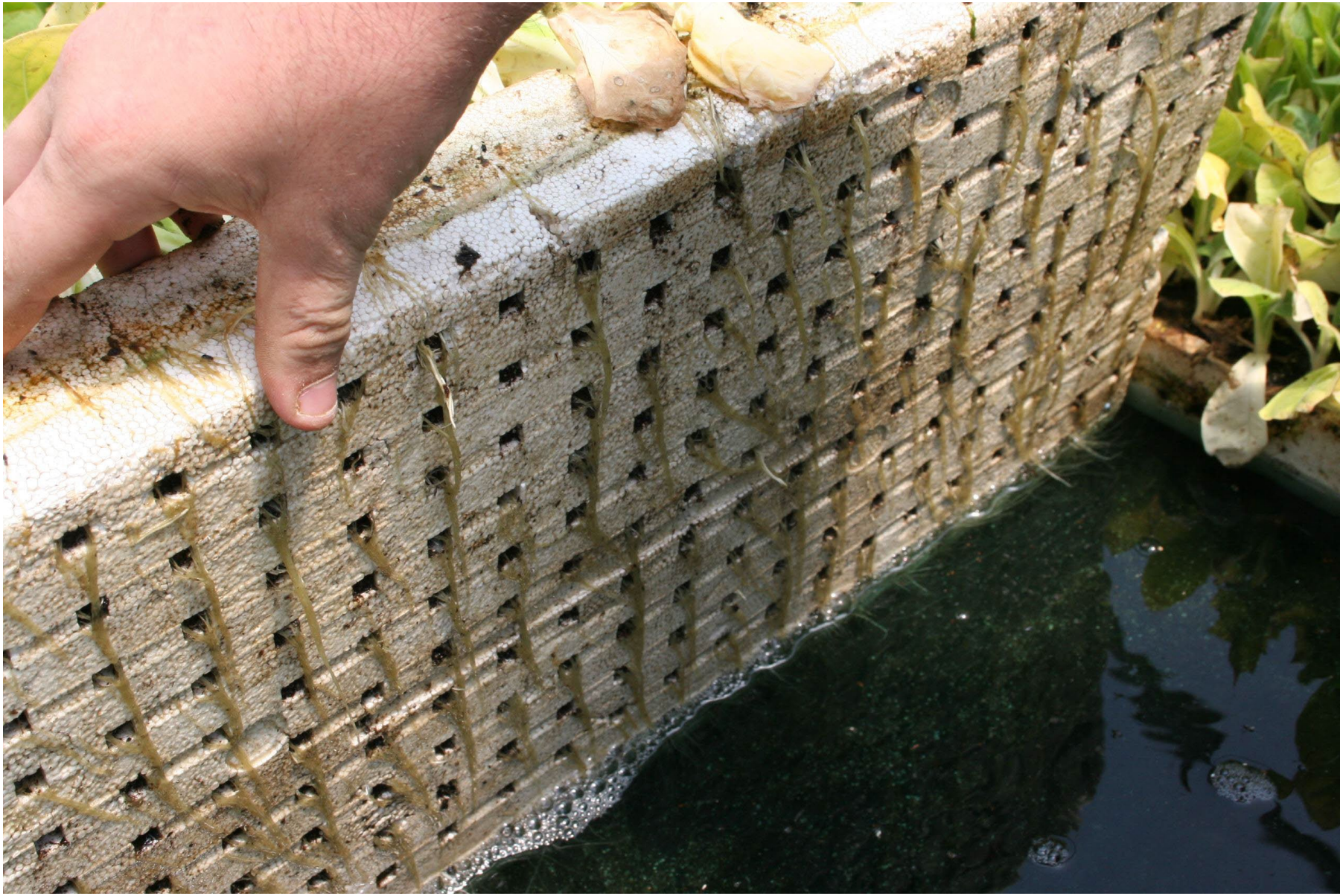
Pythium Root Rot

***Pythium* spp.**

Pythium Root Rot



Managing Pythium Root Rot

- Cultural practices
  - Sanitation (keep pathogen out of system)
  - Clean float-trays
  - Use “clean” water
  - Keep soil out of bays
- Fungicides
  - Terramaster EC (etridiazole)
  - Best used preventatively

Rhizoctonia damping-off

Rhizoctonia solani

Rhizoctonia damping-off

Target spot

Sclerotinia collar rot

Sclerotinia sclerotiorum

Sclerotinia collar rot


Black Leg = Bacterial Soft Rot
Erwinia spp.

Foliar Pesticides for Use in Float Beds

Fungicides

- Manzate Pro-Stick (mancozeb): preventative fungicide for rhizoctonia diseases (damping off, target spot)
  - 1 tablespoon/gal or 0.5 lb per 100 gal, apply 3 to 12 gallons per 1000 ft^2 (400 trays)
  - Wait until plants are at least dime-size to spray, many want until clipping
- Quadris (azoxystrobin): can make 1 application on float plants for target spot
  - About 5 cc (5 mL) per 5 gal per 1000 ft^2 (400 trays)
- Streptomycin (Harbour): bacterial soft rot (black leg)
  - 1 to 2 tablespoon/gal or 4 to 8 oz per 50 gal (8 to 16 oz per 100 gal)

Insecticides

- Orthene (acephate): insecticide for aphids, cutworms, other insects
  - 1 teaspoon/gal or 1 tablespoon/3 gal
- Dipel (*Bt*): Cutworms
  - 2 teaspoons/gal

Terramaster 4EC in Float Water for *Pythium*

- Use new trays – most important step in reducing Pythium
- Apply 0.7 to 1 oz Terramaster 4EC per 100 gal float water at about 3 weeks after seeding (when roots first enter water)
- Can be applied up to 3 times if needed (2.8 oz/100 gal total for season).
- Apply with injection system preferably and distribute with sump pump.
- 1 application is usually sufficient if using new trays and March seeding
- More than 1 application may be needed for sanitized trays or April seeding
- Watch roots under trays at least weekly for tan/brown slimy appearance
- Be aware that Terramaster will remove all roots under tray for short period of time (4-7 days after application), but course healthy white roots grow back quickly. Growth will be slowed for 7-10 days after application.
- Terramaster can be used to 'hold' plants when ready to transplant but wet field conditions prevent transplanting.

Questions

Andy Bailey

UKREC, Princeton KY

March 26, 2024