CLEAN WATER WITH PLANTS & WOOD CHIPS

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Water challenges & concerns

Contaminants?
Availability?
Salts
Aquatic weeds
Pesticides
Pathogens

Irrigation timing?
Cultural practices?
Plant diseases?

How much have I lost?
$ and opportunity cost
Treatment technologies for runoff

- Filter strips
- Floating wetlands
- Wood chip bioreactors

Treatment technologies: Plants

- Slows water
- Absorbs
  - nutrients
  - trace metals
  - other compounds
- Microbes
  - Habitat (surface area)
  - carbon source
Filter strips

Bands of vegetation used between production areas & retention ponds

- Slow runoff
- Trap:
  - Sediment
  - Fertilizer
  - Pesticides
  - (potentially) pathogens

Before they enter surface water

Floating Treatment Wetlands

+ N

+ P
Floating treatment wetlands (FTWs)

Algae & duckweed control

Alkalinity, pH & nutrient management
Alkalinity & Acidity

Greenhouse irrigation water ranges across US and Canada
pH: 3.3 to 10.4
alkalinity: 2 to 575 mg·L⁻¹ CaCO₃

Assume runoff from irrigation maintains similar water quality measures

Do ranges in alkalinity & pH of runoff affect bioremediation efficacy?

Acidity (pH)

Iris ensata

Panicum hemitomon

Alkalinity (CaCO₃ mg/L)

Iris ensata

Panicum hemitomon

Plant selections for FTWs
Plant Selection

- Canna 'Firebird'
- Iris ensata
- Panicum virgatum
- Carex stricta
- Agrostis alba

Nutrient loading & FTW efficacy

Swiss Chard

2013 Nitrogen (mg/m²/d)

- Average N (mg/m²/d)
- Influent HIGH
- Influent MOD
- Effluent HIGH
- Effluent MOD
Swiss Chard

Phosphorus mg/m²/d

Average P (mg/m²/d)

Swiss Chard
High: 156 ± 7.37
Mod: 75.4 ± 4.06

Swiss Chard
High 156 ± 7.37
Mod 75.4 ± 4.06

Maintenance of FTWs: weeds & harvest

Agrostis Canna Carex/Sedge Juncus Marigold

Inflow Outflow

P fixed (g/m²/harvest)

N uptake in 5 species

Inflow Outflow
Harvest timing

End-uses of harvested material

Average Evaluative Rating of each Species over 8 weeks
Treatment Technology: Wood chip bioreactors (Carbon wall)

- Subsurface trenches - filled with wood chips (¼ to 1")
- Water flows through trench
- Wood chips - substrate for bacteria that reduce nitrate to N gas via denitrification
Why bioreactors?

- Require no modification of current practices
- No land removed from production
- No decrease in drainage effectiveness
- Require little to no maintenance
- Last for up to 20 years
- Cost effective

Nitrate-N removal & wood-chip bioreactors

Pesticides & wood-chip bioreactors

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<th>Analyte</th>
<th>Bioreactor inlet (ppb)</th>
<th>Bioreactor outlet (ppb)</th>
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Sea Mist Farms Bioreactor

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