CONTROLLED-RELEASE NITROGEN IN TREE NURSERIES

Ryosuke Fujinuma
Nick J. Balster

Department of Soil Science
University of Wisconsin – Madison

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Bare-root Forest Nursery

- Over 20 million seedling produce
  - Hardwood & softwood
  - Larger seedling is better
  - Intensive fertilizer application

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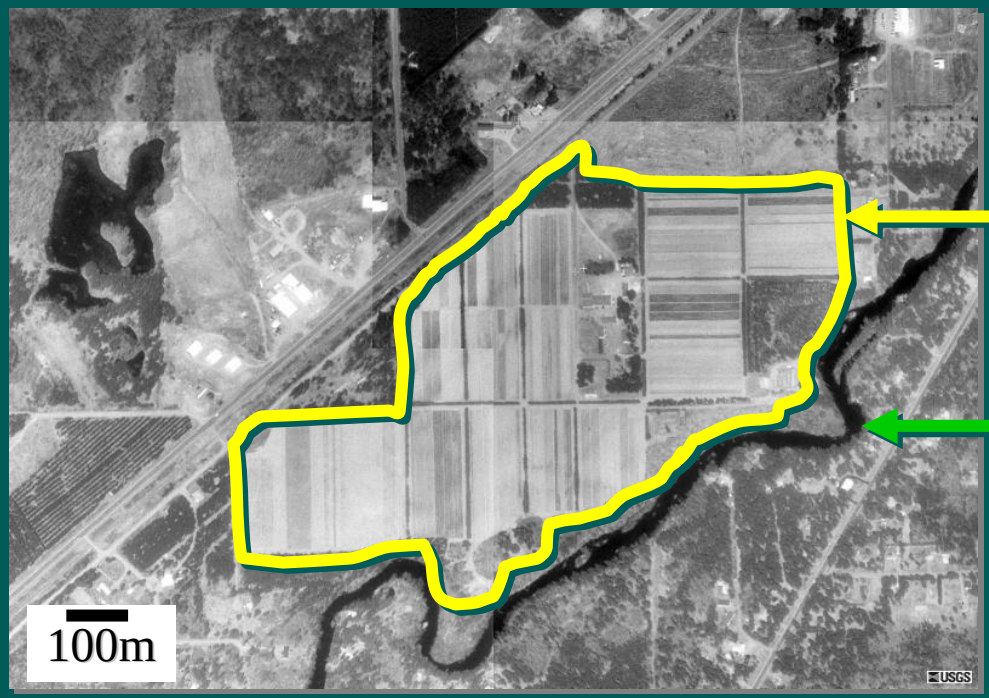
Major source of nitrate ground water contamination

(US-EPA, 2006)

Nitrogen Budget

$$N_{net\text{-}min} + N_{deposition} + N_{fertilizer} - N_{uptake} = N_{leaching}$$



Hayward, WI

USGS

Reduce Nitrogen Leaching

- Best management practices
  - Synchronize the timing between plant demand and nitrogen supply
    - Conventional Fertilizer (Conv)
      - Multiple-even applications
    - Control Release Fertilizers (CRF)
      - Single application

Nitrogen release
CRF

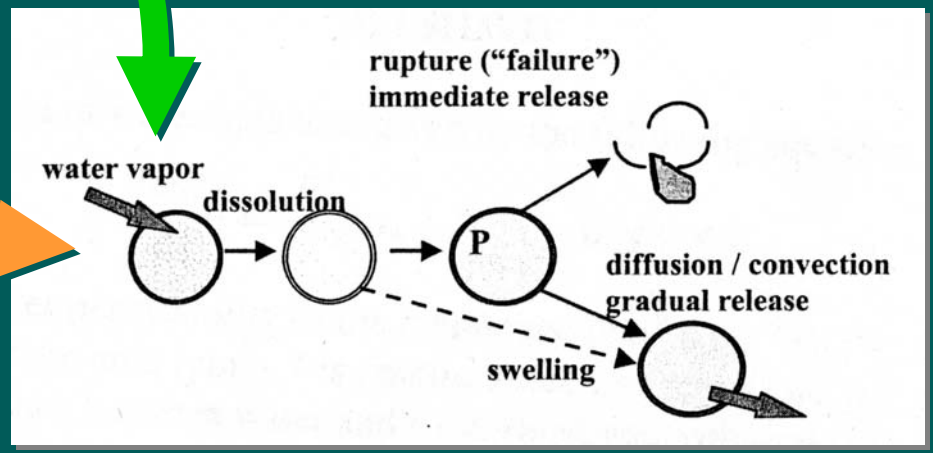
- Controls
  - Soil moisture
  - Soil temperature

Soil type

Irrigation

Permeability

of coating materials



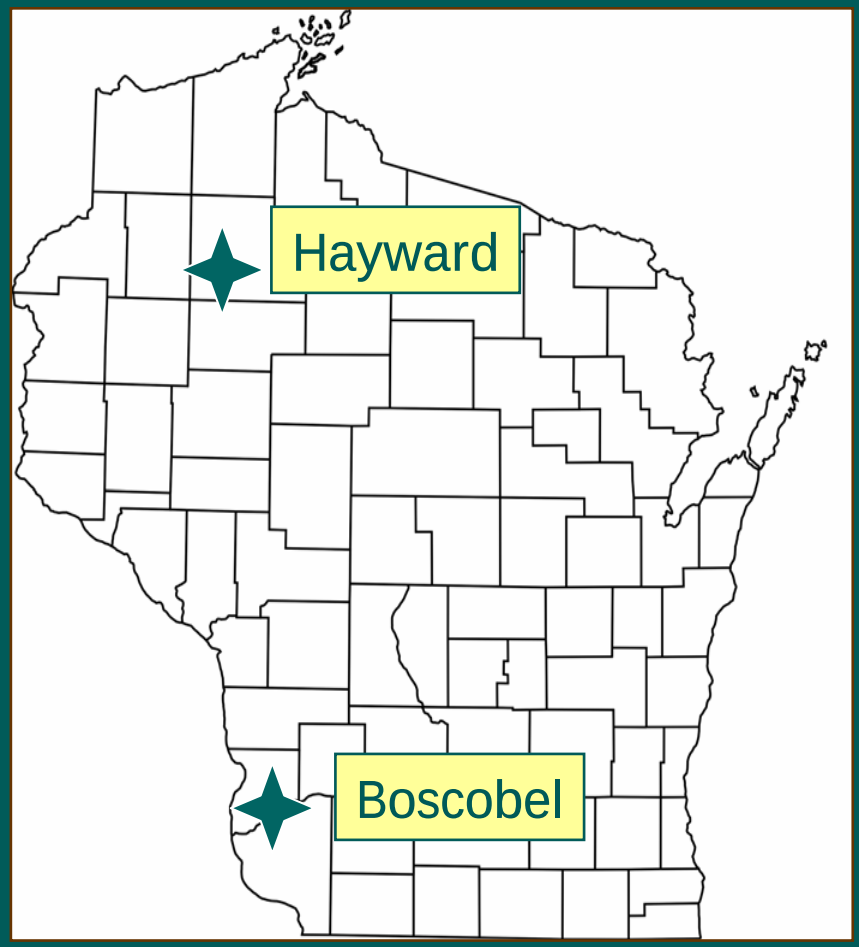
(Shaviv 2001)

Hypotheses

1. CRF management will achieve higher seedling growth relative to Conv by synchronizing N input and N demand of seedlings.

2. CRF management will result in reduced N leaching relative to Conv due to higher nutrient use efficiency.

Experimental Design



Wisconsin, USA

- 2 sites
- 2 treatments per site
  - Conv: 192 kgN ha^{-1} yr^{-1}
    - 8 applications of 24 kgN ha^{-1}
  - CRF: 192 kgN ha^{-1} yr^{-1}
    - 2 application of 96 kgN ha^{-1}
- Northern Red Oak (*Quercus Rubra*)

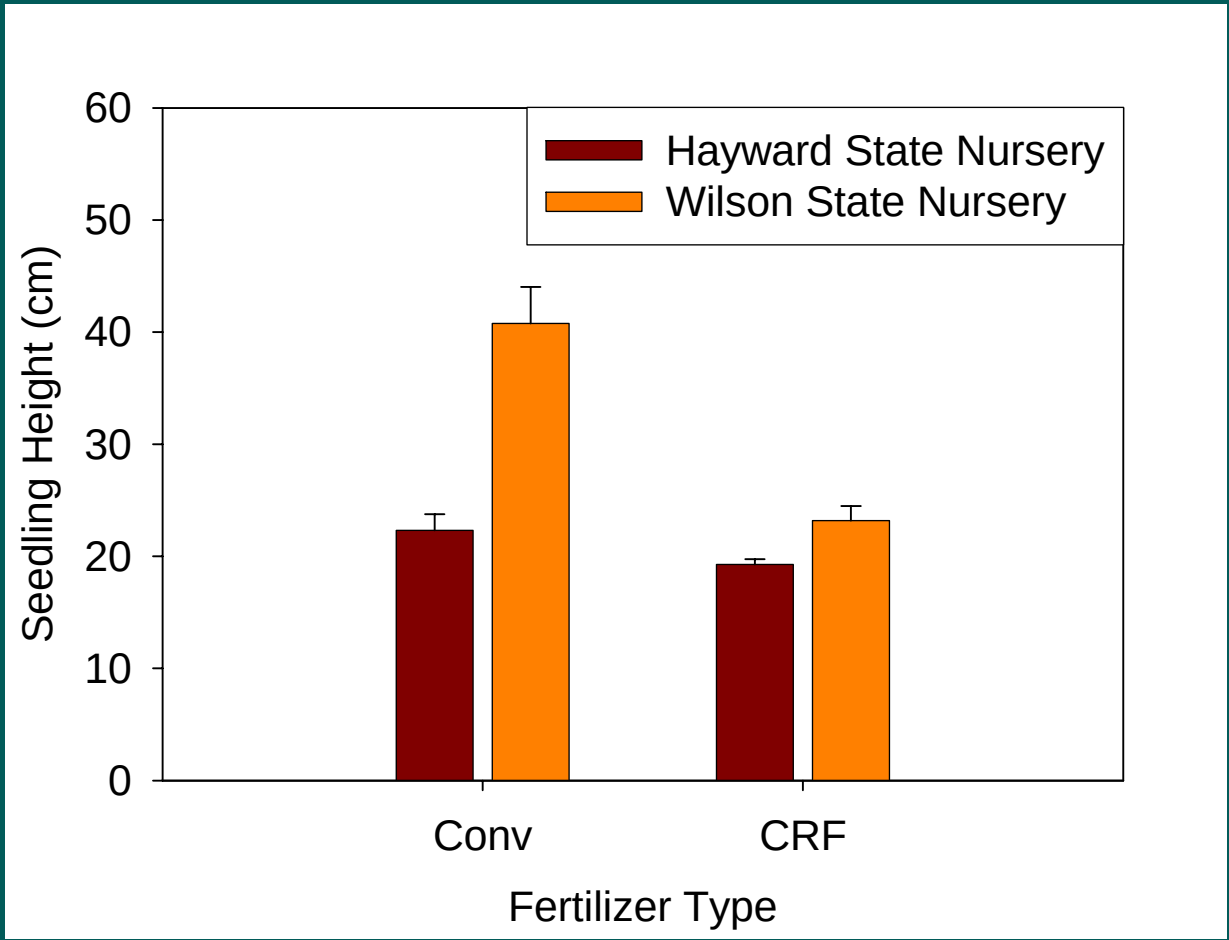
Methods

- N Input
  - Precipitation & Irrigation
  - Fertilizer
  - Mineralization
- N Output
  - Biomass uptake
  - Leaching
- N Storage
  - Soil
- Samples taken 2005

- Analyses
  - Biomass (0.01 g)
  - Total N
    - soil, biomass (0.1 %)
  - Solution N
    - NH_4^+, NO_3^- (0.1 mgN L^{-1})

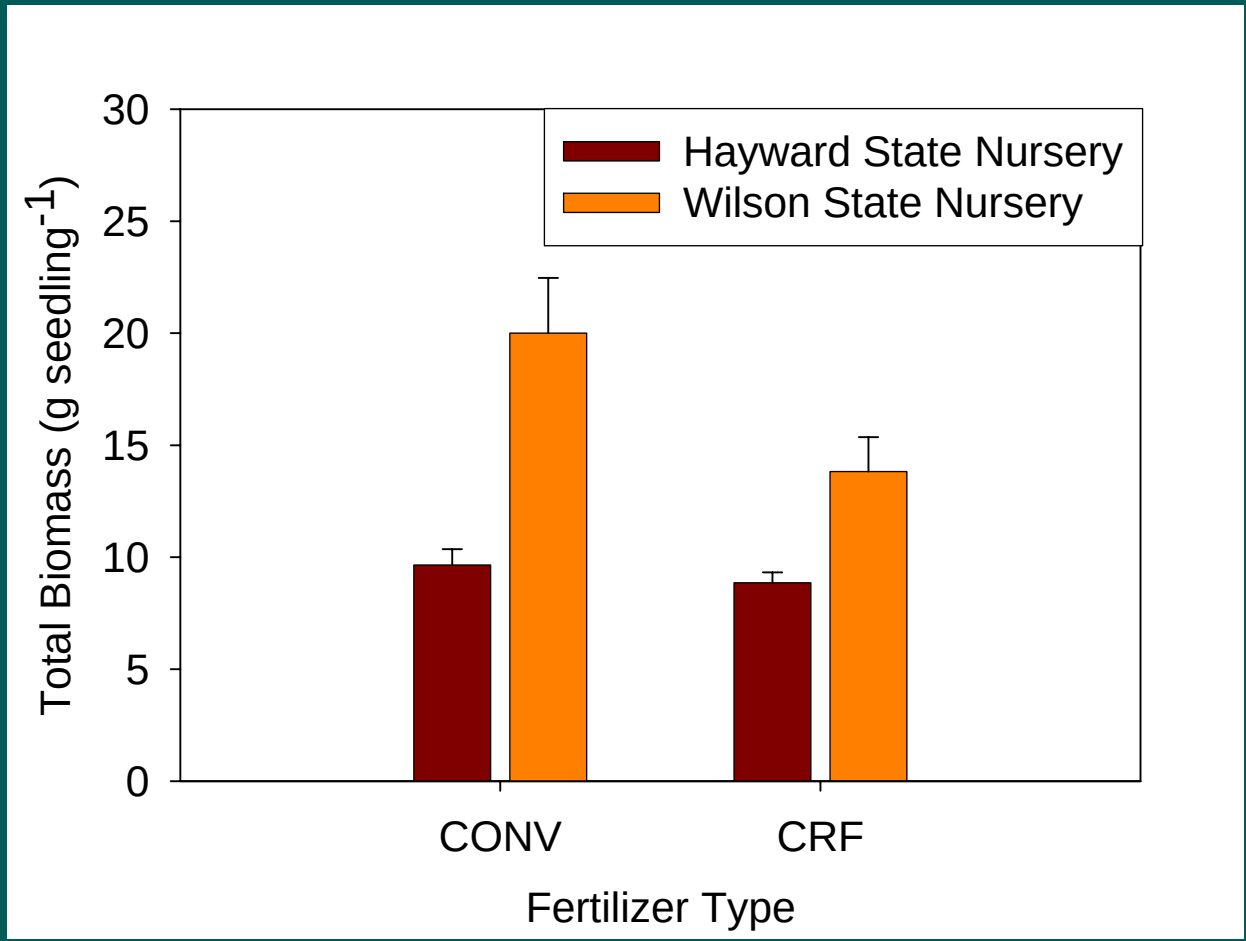
Results

First Year Northern Red Oak



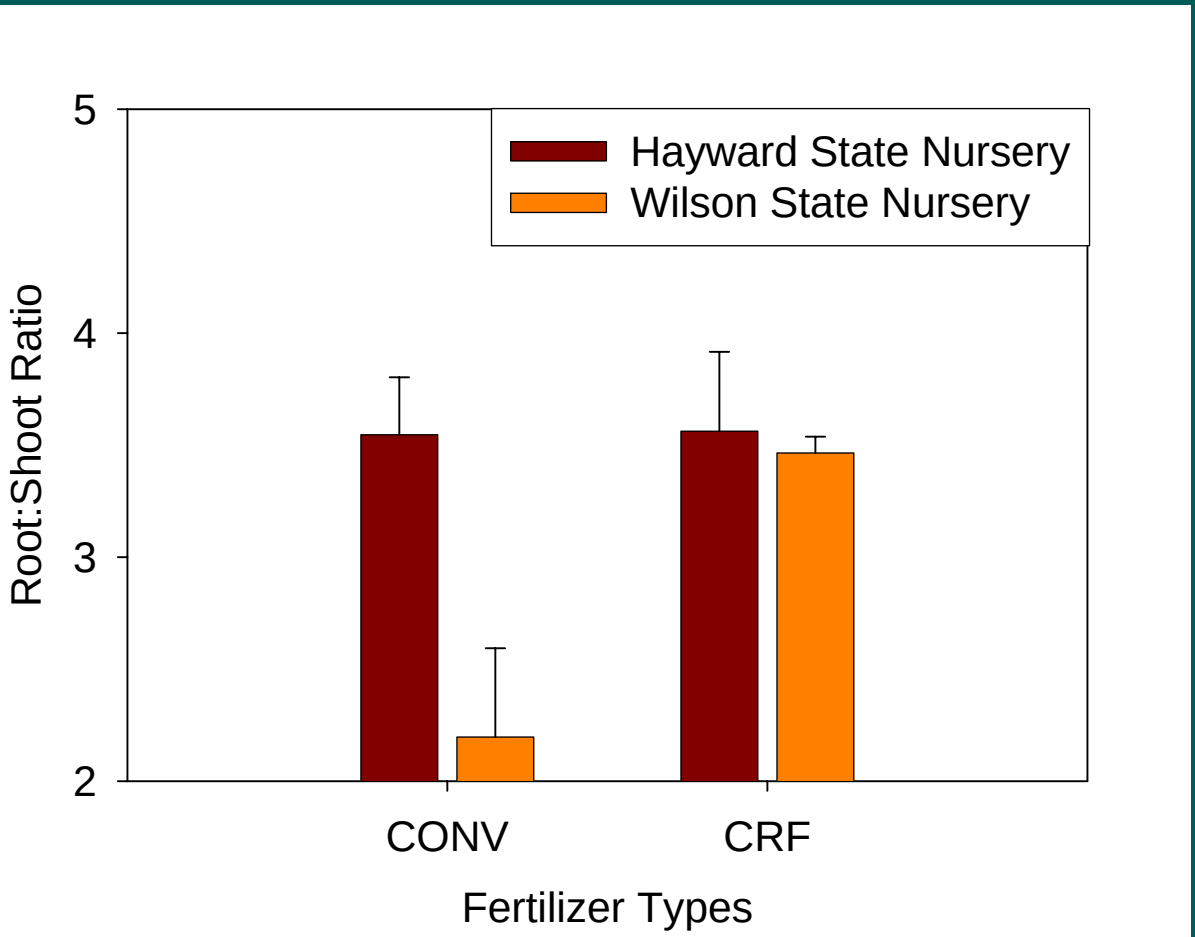
Results

Biomass



Results

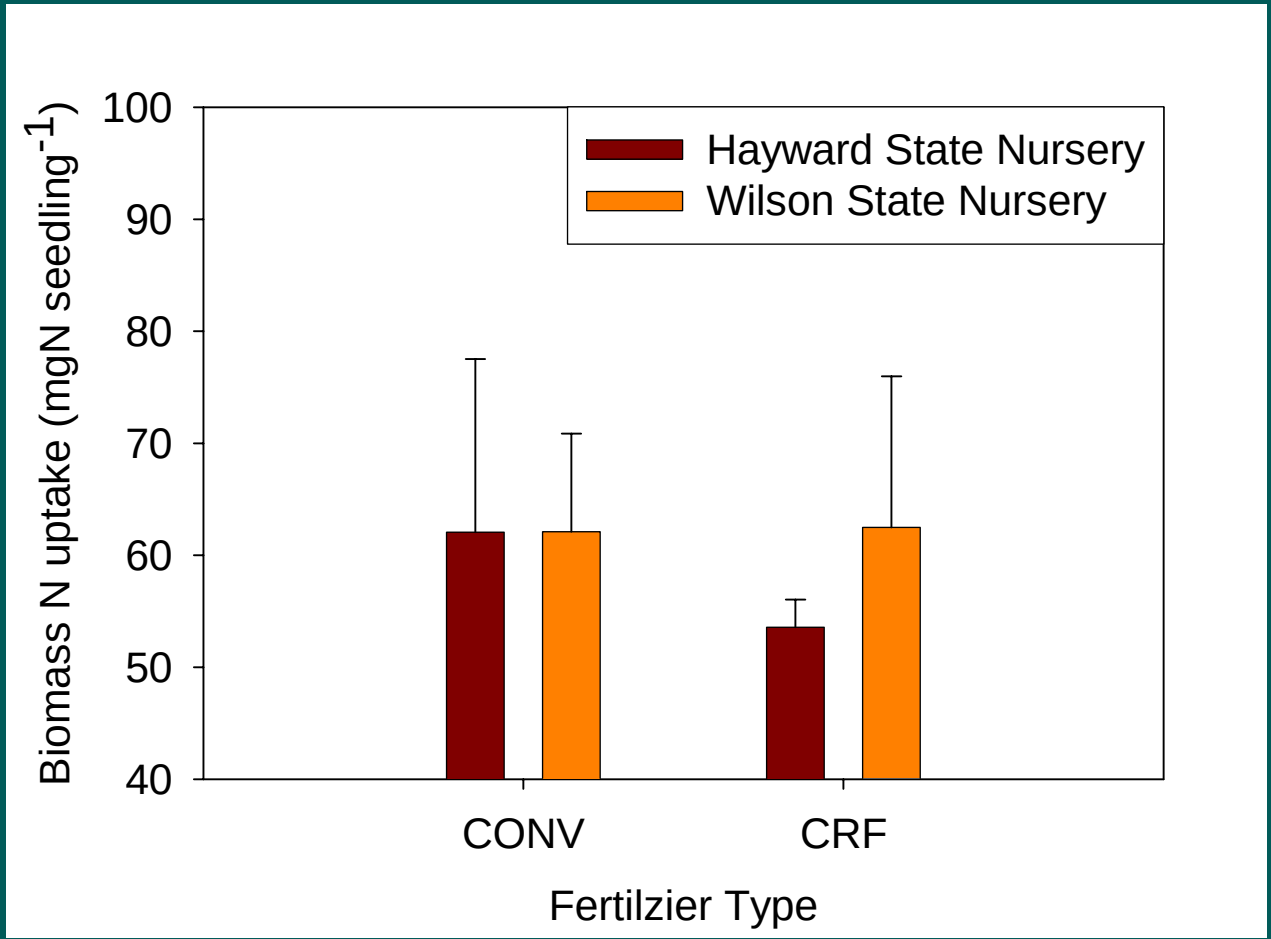
Root:Shoot Ratio



- CONV grow more aboveground than belowground
- CRF shows consistent Root:Shoot ratio

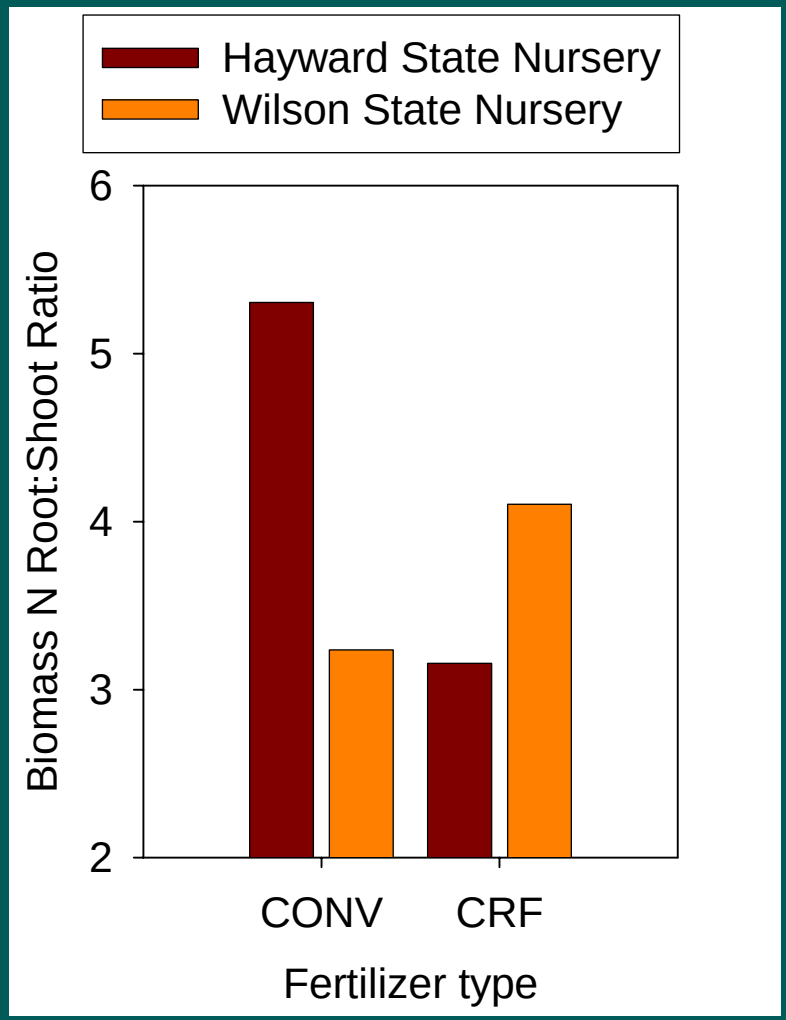
Results

Biomass N Uptake



Results

Biomass Nitrogen Allocation



- Hayward Conventional

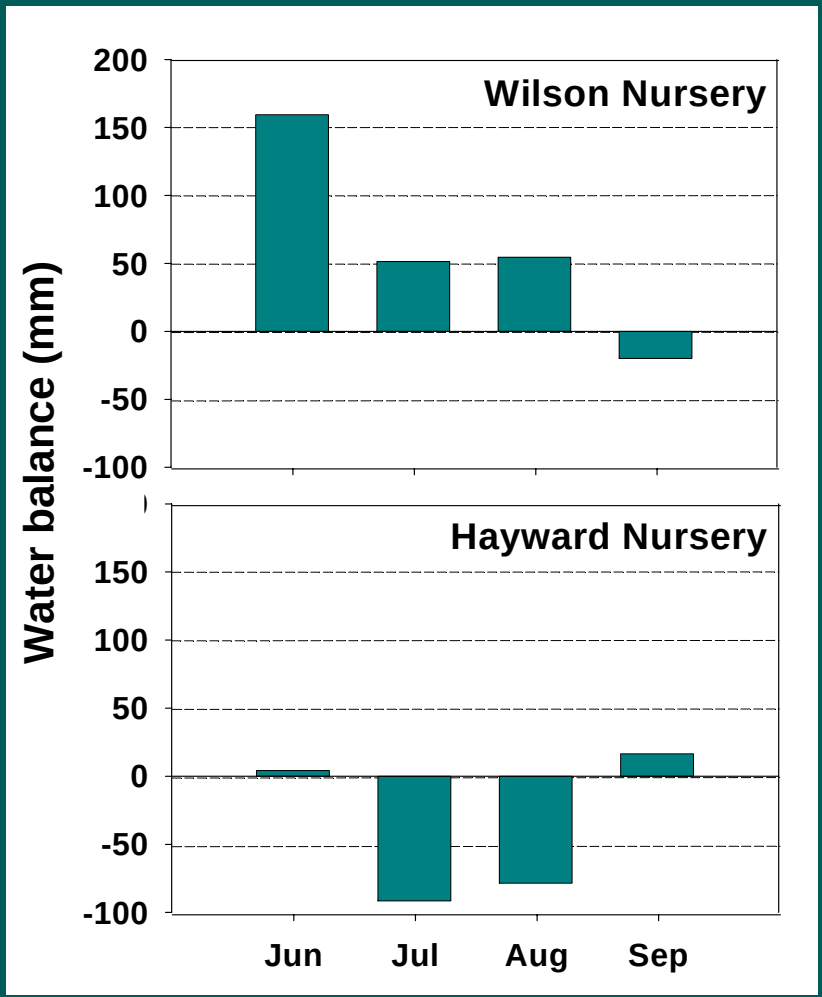
  N aboveground < belowground

- Boscobel Conventional

  N aboveground > belowground

Results

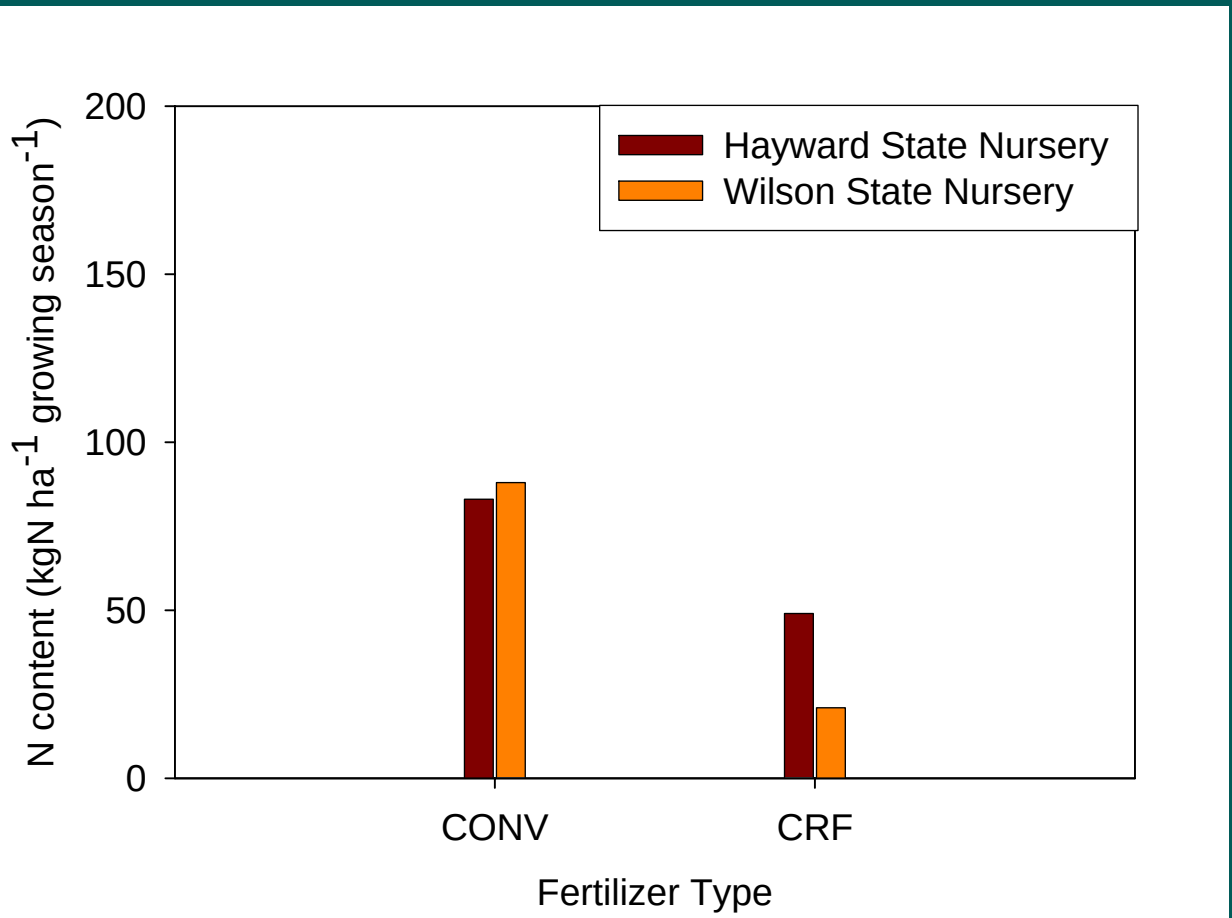
Water Balance



- Difference between water input and PET
  - ➢ Negative = water stress
- Seedlings in Boscobel had sufficient water
- Seedlings in Hayward had deficient water

Results

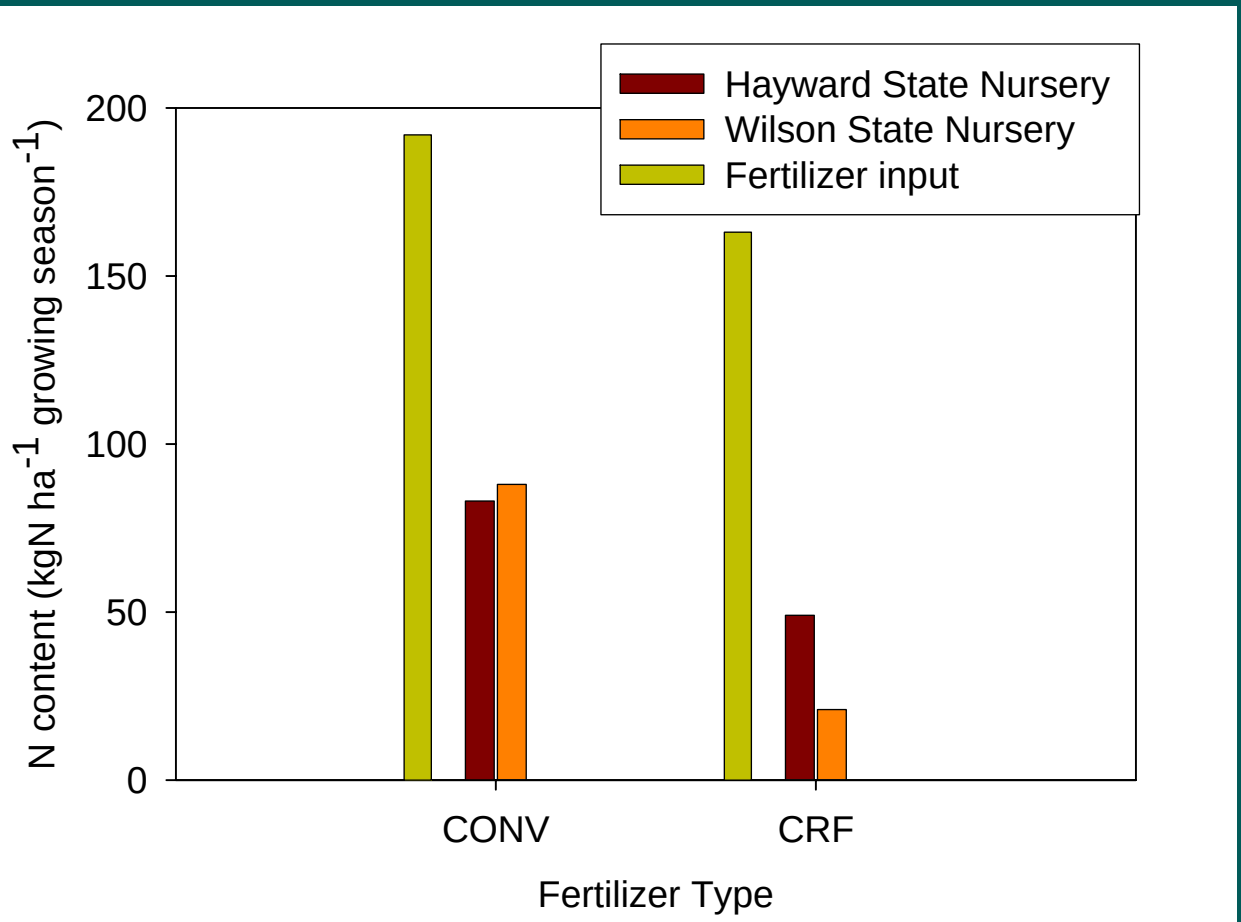
Nitrogen Leaching

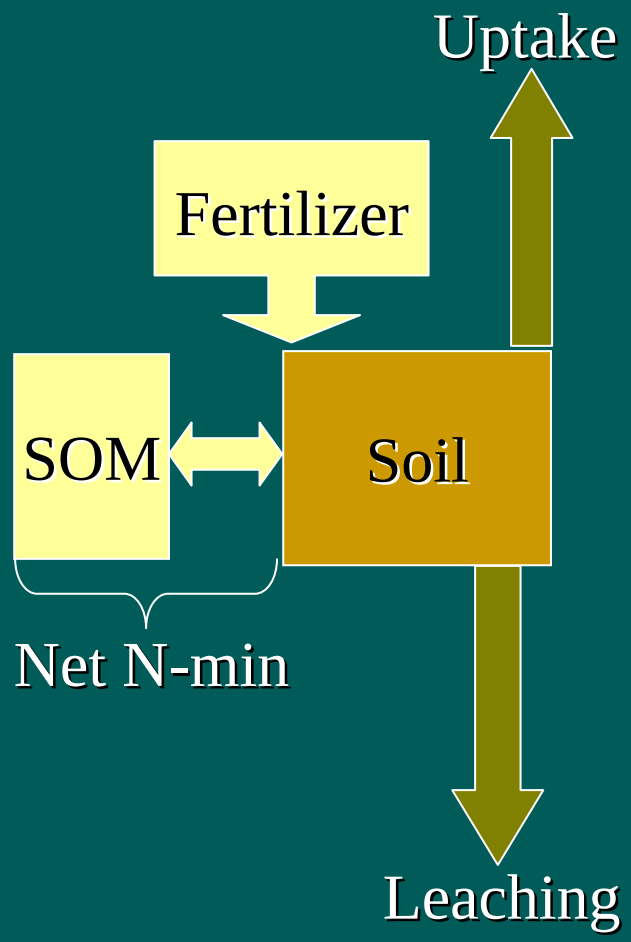


- CONV > CRF
  - Up to 60%

Results

Nitrogen Leaching





Conclusion

- Fertilizer application can differ the physical properties of the seedling growth; Conv > CRF .
- CRF application allocate biomass N to belowground biomass than Conventional fertilizer application.
- CRF application could reduce the N leaching from nursery system up to 60% compare with Conventional fertilizer application.
- The effects of fertilizer application on N uptake could be altered by water management in nurseries.

Acknowledgement

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