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# **Genotypic Differences in Nodulation and Growth of Diverse Red clover Cultivars Under Different Levels of Nitrogen Fertilization**

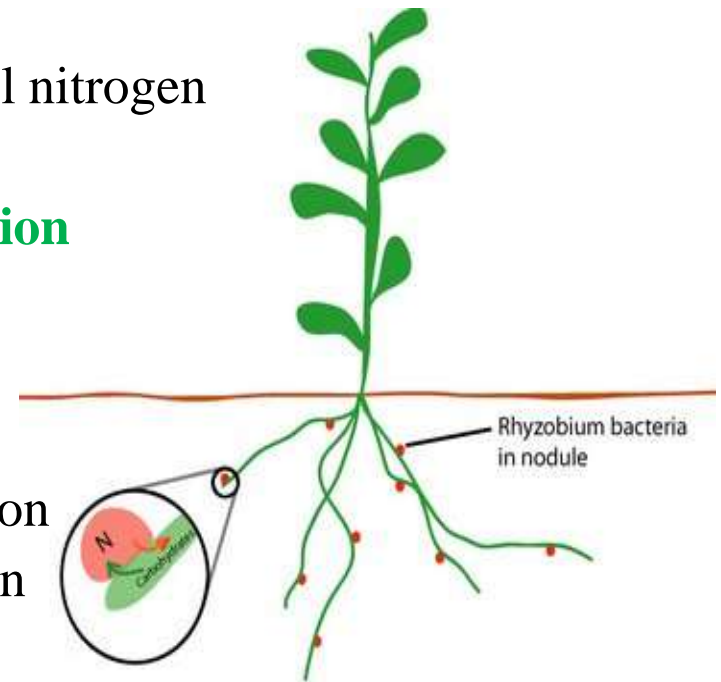
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**Canada** 

# Effect of Nitrogen on Nodulation

- **Nodulation is very important for legumes**
  - Especially under limited of available soil nitrogen
- **Nodule formation and subsequent N fixation**
  - very sensitive to external N availability
- **Availability of N;**
  - at low concentration – promote nodulation
  - at high concentration – inhibit nodulation
- **Genotypic differences in response to external N**
  - Species level (Whittington et al. 2012)
  - Cultivar level (Thilakarathna et al. 2012)



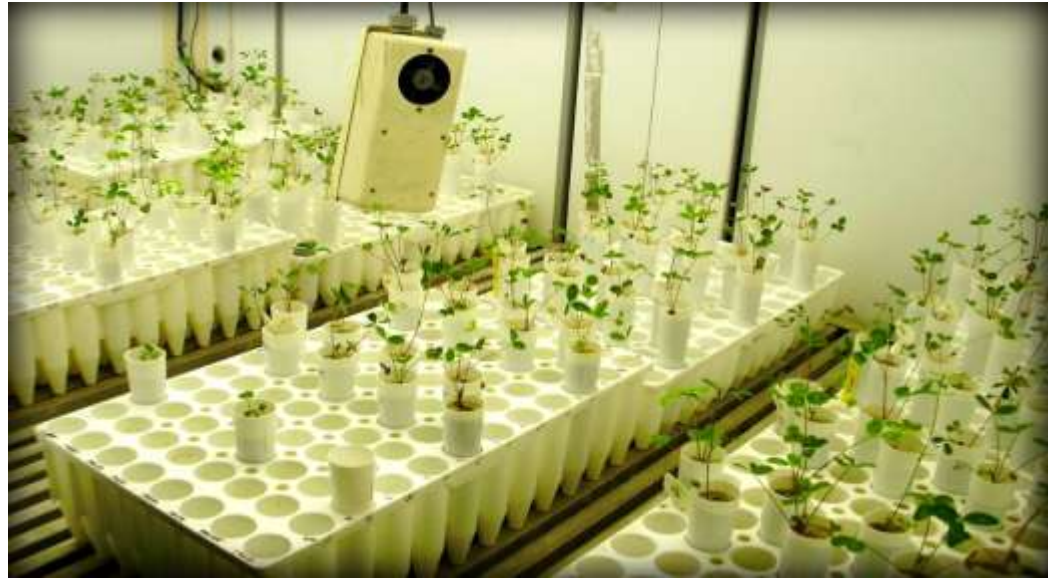
**Detailed information on how soil N affects nodulation and the impact on initial plant growth are lacking**

## **Objective**

**To investigate the genetic variability between different red clover cultivars for effective nodulation under different N fertilization**



# Material & Methods



- Pre-germinated seedlings
- **7 days**, Inoculated *Rhizobium leguminosarum* biovar *trifolii*
- **Growing conditions:**
  - Photoperiod of 16 D: 8 N
  - $425 \mu\text{mol m}^{-2} \text{s}^{-1}$  &  $23 \pm 2 \text{ }^\circ\text{C}$
- Growth period: 8 weeks



# Material & Methods

## Red Clover Cultivars

- **Diploid**
  - AC Christie
  - Tapani
  - CRS 15
- **Tetraploid**
  - Tempus
  - CRS 18
  - CRS 39



## Nitrogen concentrations (mg N plant<sup>-1</sup> week<sup>-1</sup>)

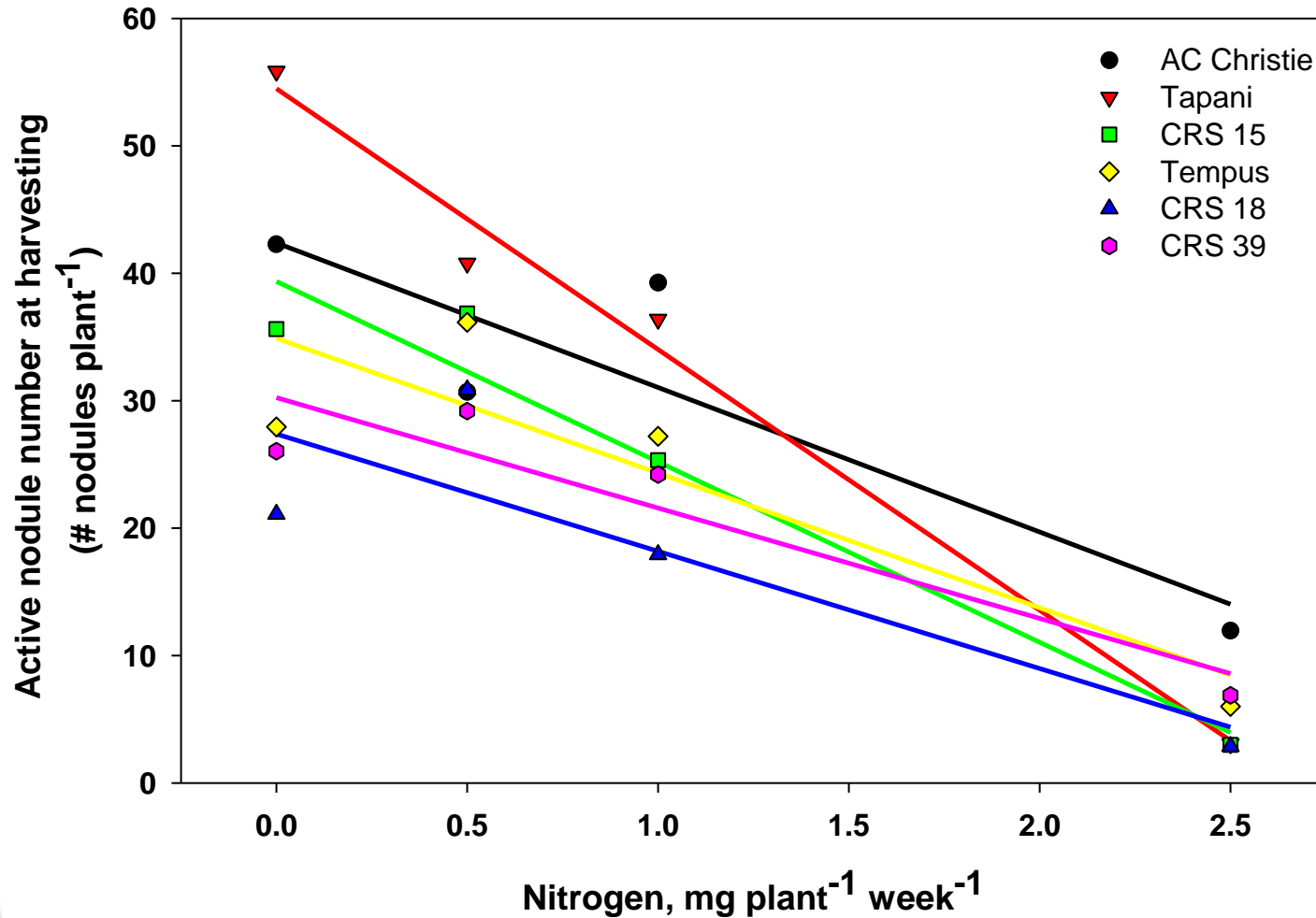
- 0
  - 0.5
  - 1.0
  - 2.5
- N Source-Ammonium sulfate
  - N fertilizer rates weekly
  - N free Hoagland's nutrient solution
  - Randomized split-plot design
    - Main plot: N fertility treatment
    - Sub plot: Red clover cultivars

# Data Collection

- **Number of active nodules at harvesting**
- **Shoot and root dry weight**
- **Shoot and root total N %**
- **Plant morphological characteristics**

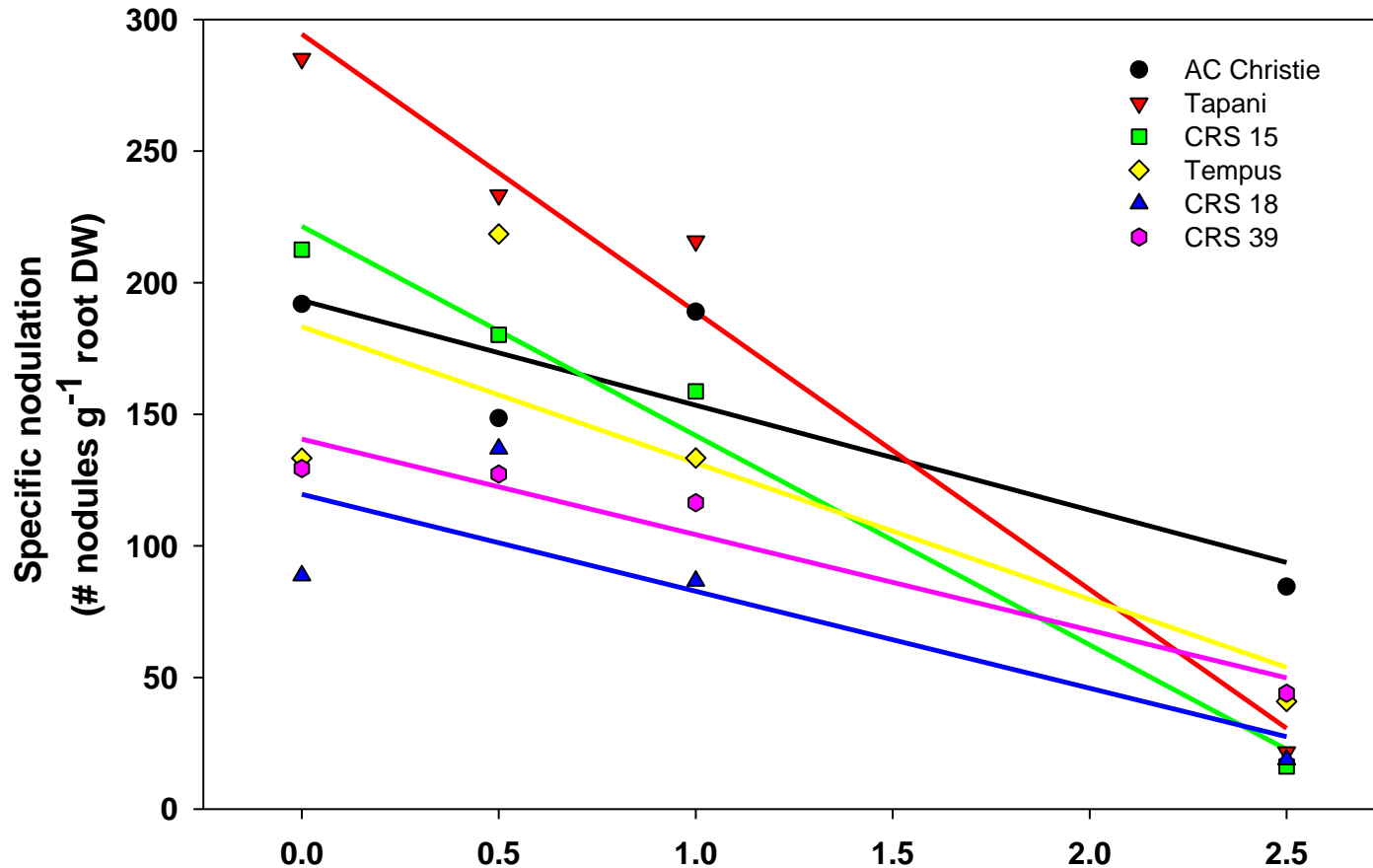


# Active Nodule Number



Nitrogen x Cv;  $p = 0.083$   
lin N. Dip vs Tetra;  $p = 0.019$

# Specific Nodulation (nodules $\text{g}^{-1}$ root DW)

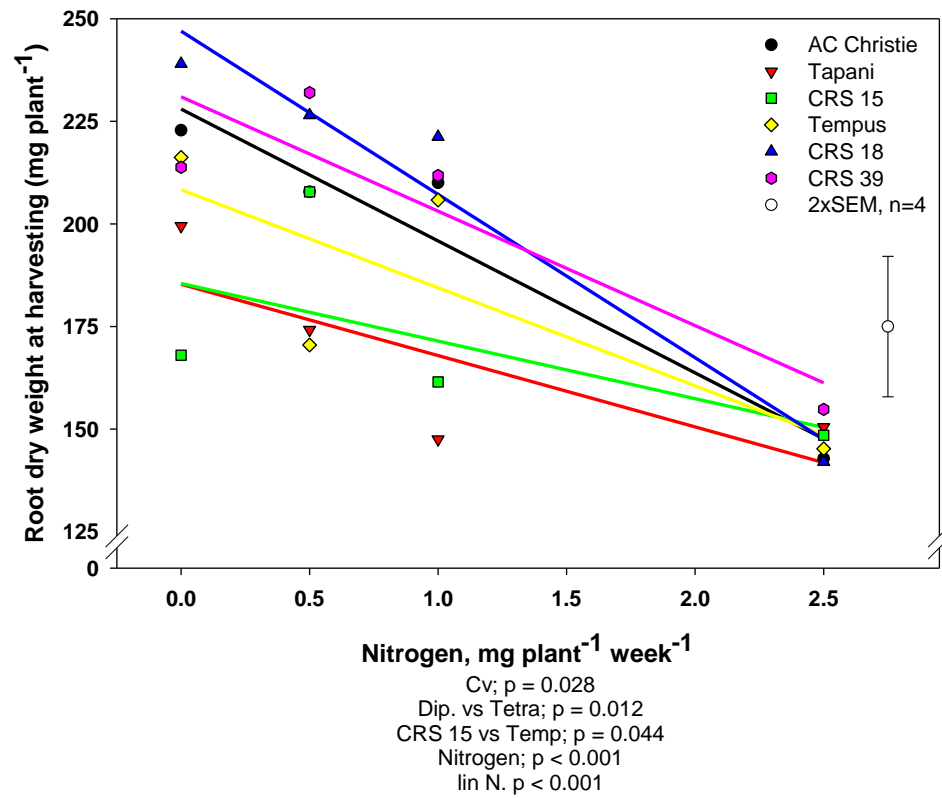
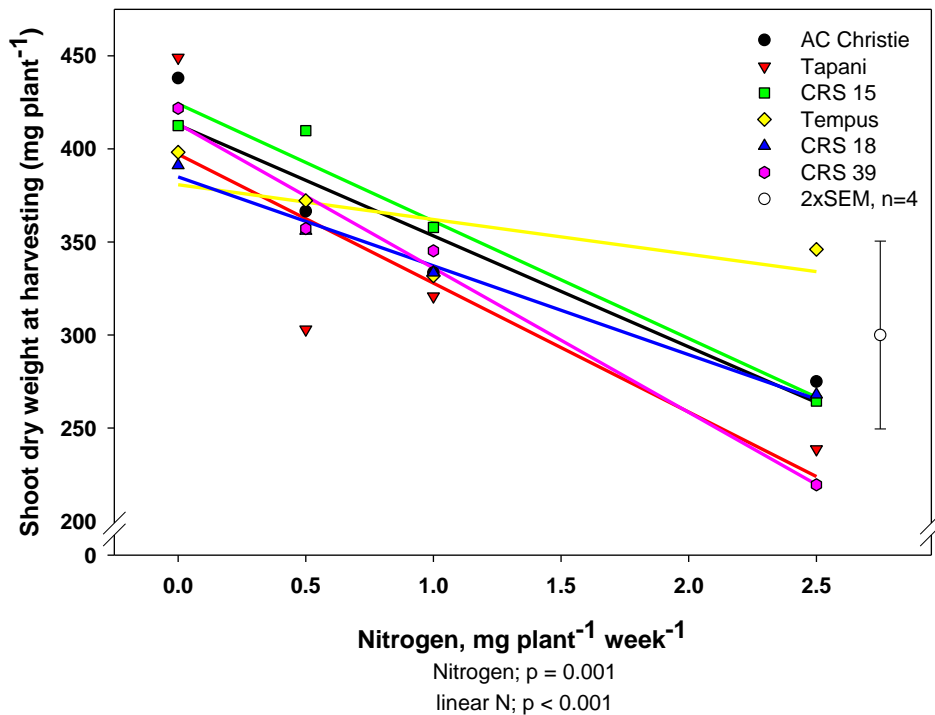


Nitrogen,  $\text{mg plant}^{-1} \text{ week}^{-1}$

Nitrogen x Cv;  $p = 0.067$   
lin N. Dip vs Tetra;  $p = 0.022$   
lin N. CRS15 vs ACC, Tapani;  $p = 0.085$

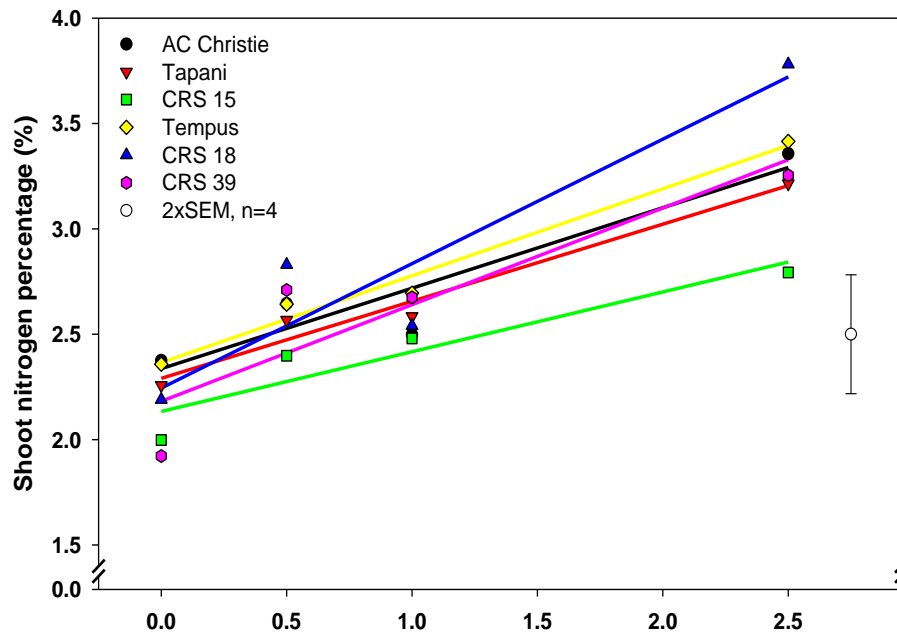


# Shoot and Root Dry Weight



# Nitrogen %

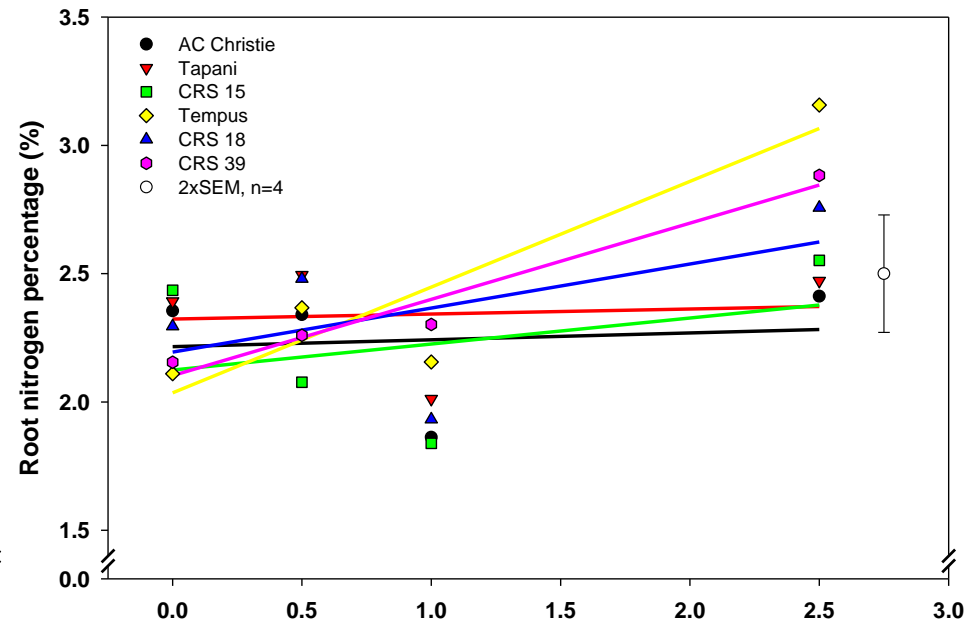
## Shoot N %



Nitrogen, mg plant<sup>-1</sup> week<sup>-1</sup>

Nitrogen;  $p = 0.020$   
 lin N.  $p = 0.003$   
 lin N. Dip vs Tetra;  $p = 0.053$

## Root N %

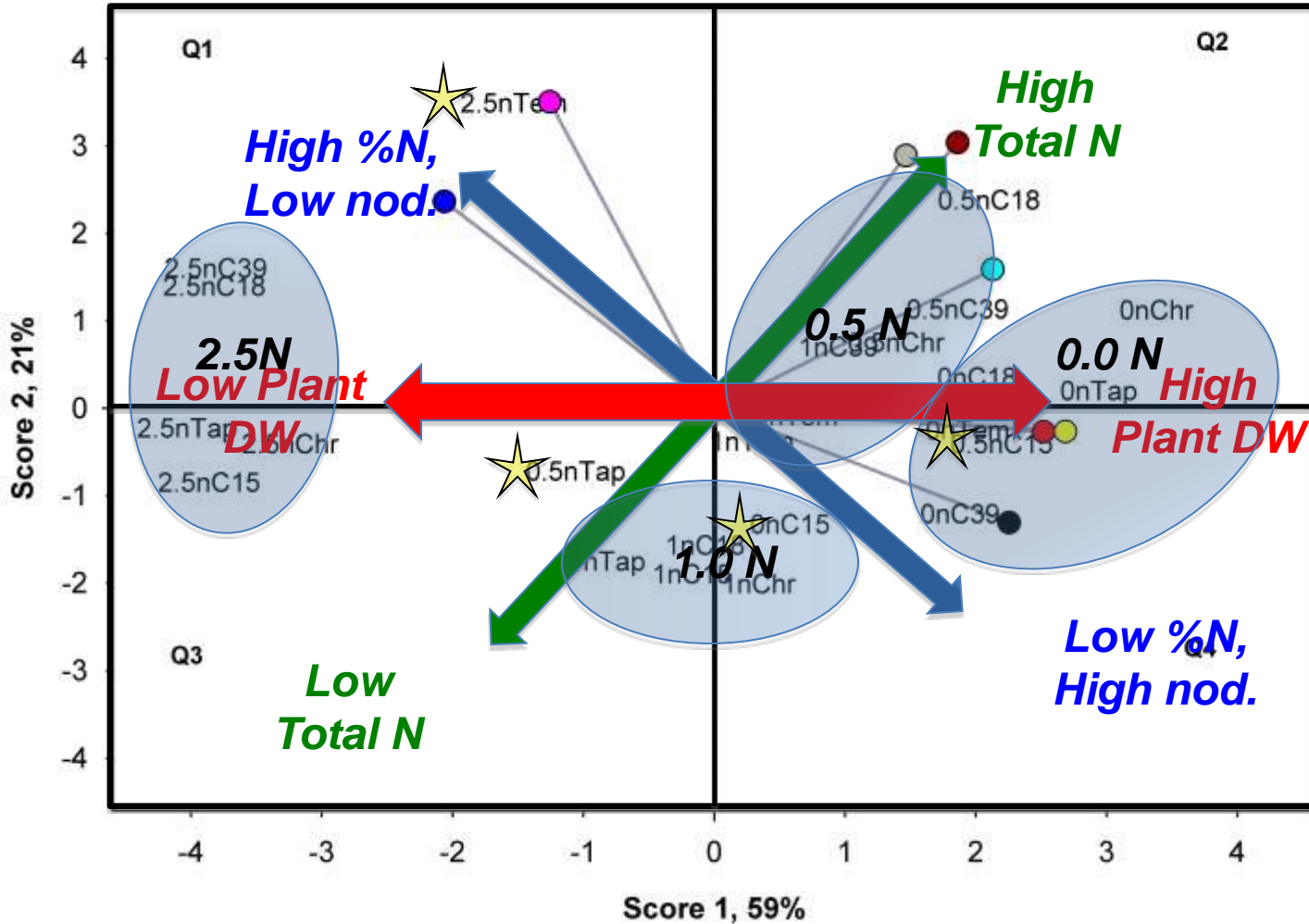


Nitrogen, mg plant<sup>-1</sup> week<sup>-1</sup>

Nit. x Cv.;  $p = 0.043$   
 lin N. Dip vs Tetra;  $p < 0.001$   
 lin N. CRS 15 vs Temp;  $p = 0.070$   
 lin N. CRS 15 vs ACC, Tapani;  $p = 0.007$



Total variation, 80%



- # Active nodules/plant
- Shoot Dry Wt
- Root Dry Wt
- Plant Dry Wt
- Shoot N %
- Root N %
- Shoot N, mg/plant
- Root N, mg/plant
- Plant N, mg/plant



# Conclusions

- This study clearly demonstrated that with respect to nodulation, RC cultivars respond differently to increasing N application rate, suggesting genetic variability for this trait.
- **Nitrogen x Cultivar interactions** may indicate that some cultivars are better adapted to low soil available N while other cultivars are better adapted to high soil available N levels



# Research Team



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**Thank you!**

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