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The role of red clover genotype in improving nitrogen fixation and transfer efficiency in legume-grass forage based production systems

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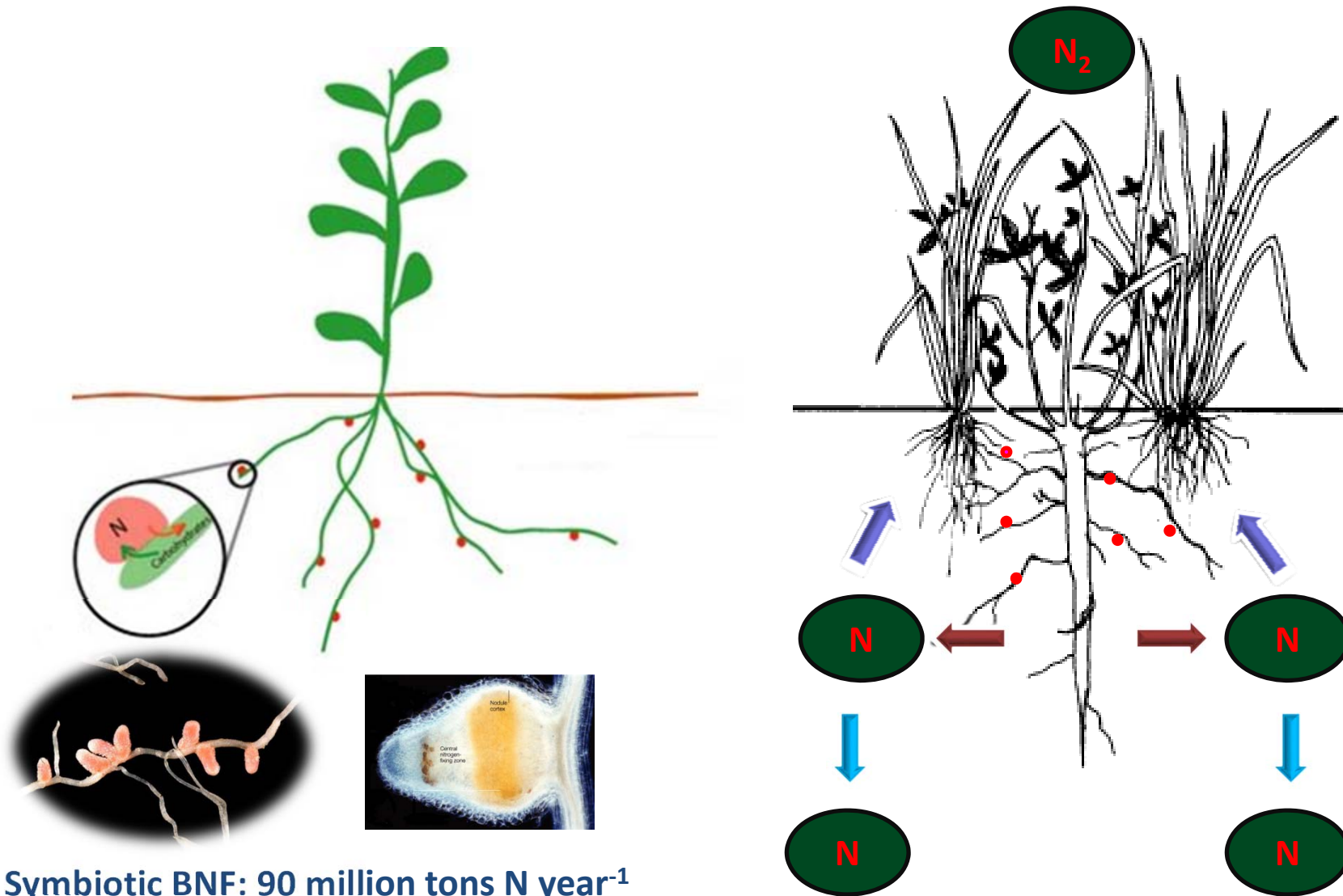
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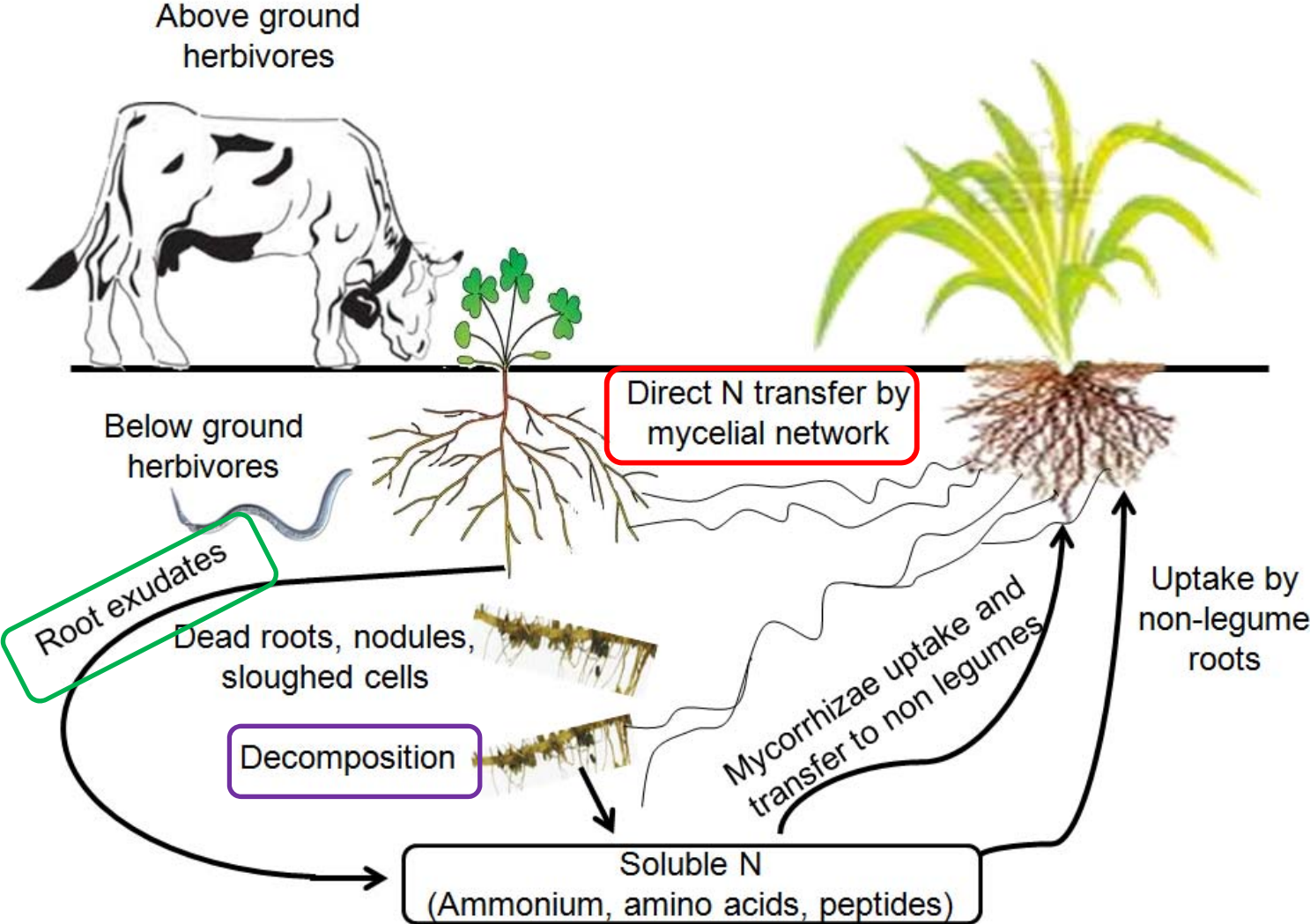


Legume-Non legume Intercropping System

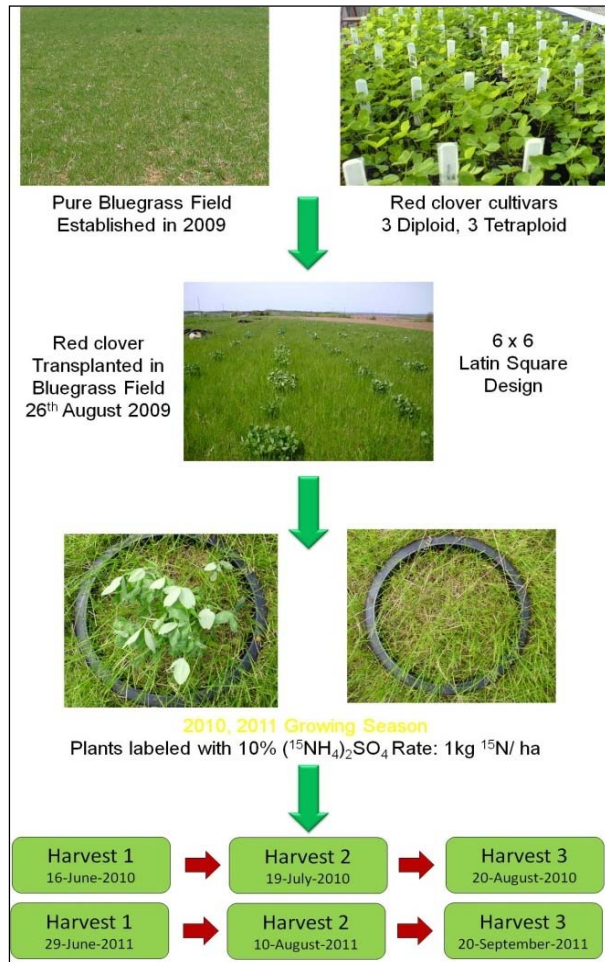


Symbiotic BNF: 90 million tons N year⁻¹

N Transfer from Legumes to Non-Legumes



Field Trial



Data collection: 2010 and 2011

- Shoot dry weight
 - Red clover cultivars
 - Bluegrass (pure and mixed stand)
- Shoot total N (%)
- Shoot ^{15}N content

Estimation of N fixation and transfer

- Isotope Dilution Technique
(Jørgensen et al. 1999)

- **N transferred (mg N plant^{-1}) from the red clover cultivars calculated using % N in bluegrass derived from bluegrass shoot N content within each plastic ring under mixed stand**

Field Trial

- **Installation of ceramic suction cups**

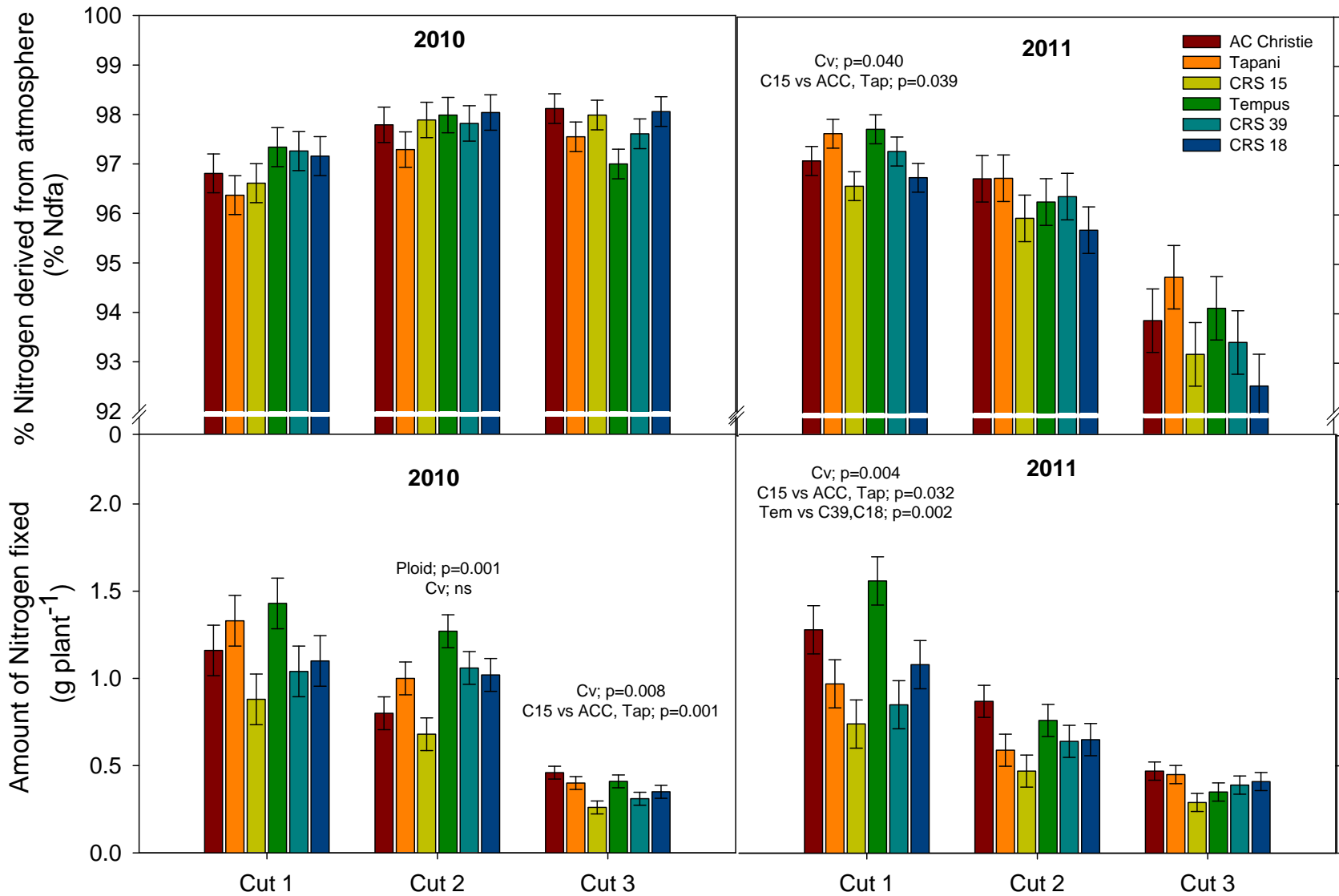
- Six red clover cultivars under bluegrass mixed stand and pure bluegrass stand
- At 45 cm soil depth
- Leachates collection from each rainfall events > 10 mm
- NO_3^- and NH_4^+ concentration of soil-water

- **Soil sampling**

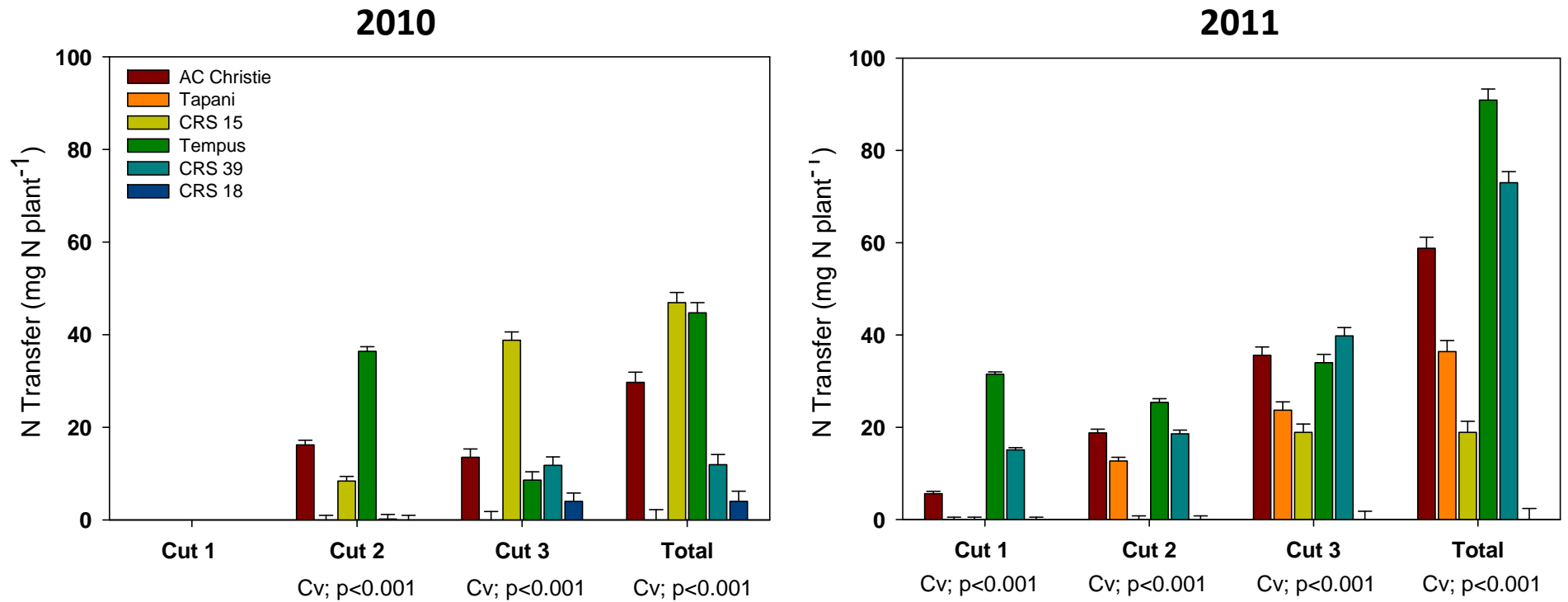
- Six red clover cultivars under bluegrass mixed stand and pure bluegrass stand
- 0-15 and 15-30 cm soil depth, each harvesting dates
- Nitrate, ammonium, total N and C



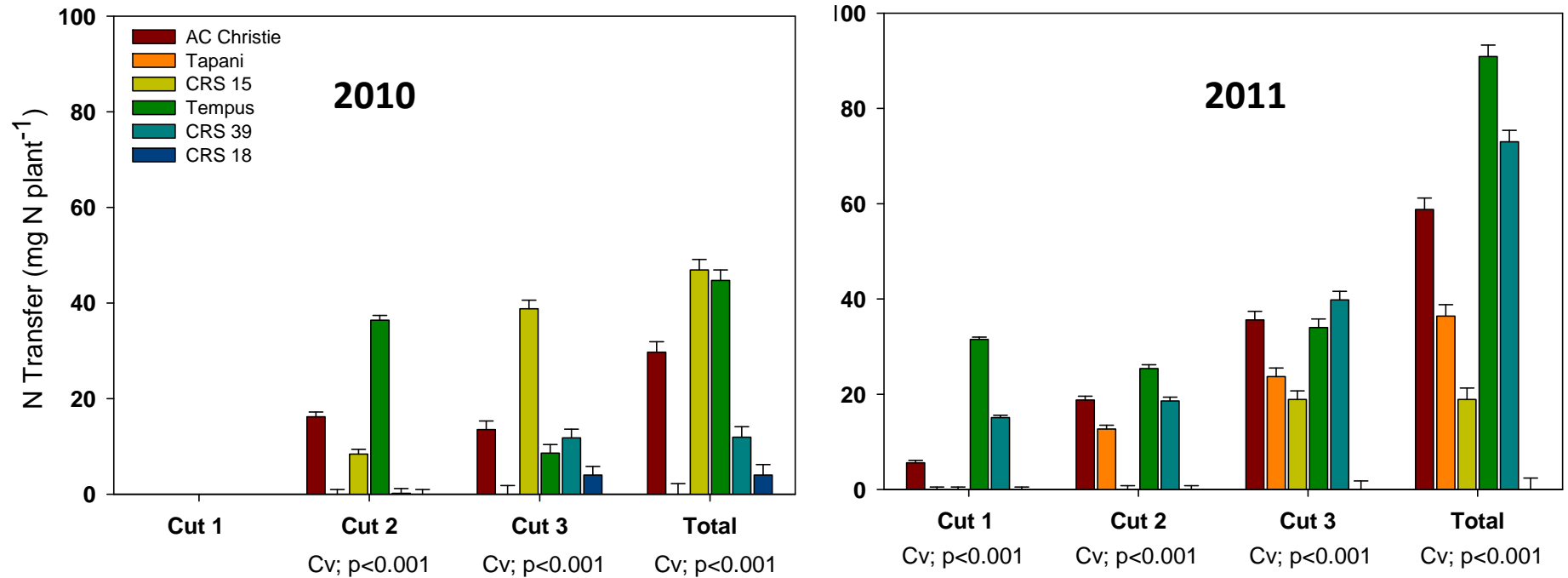
Red clover N Fixation



N Transfer



N Transfer



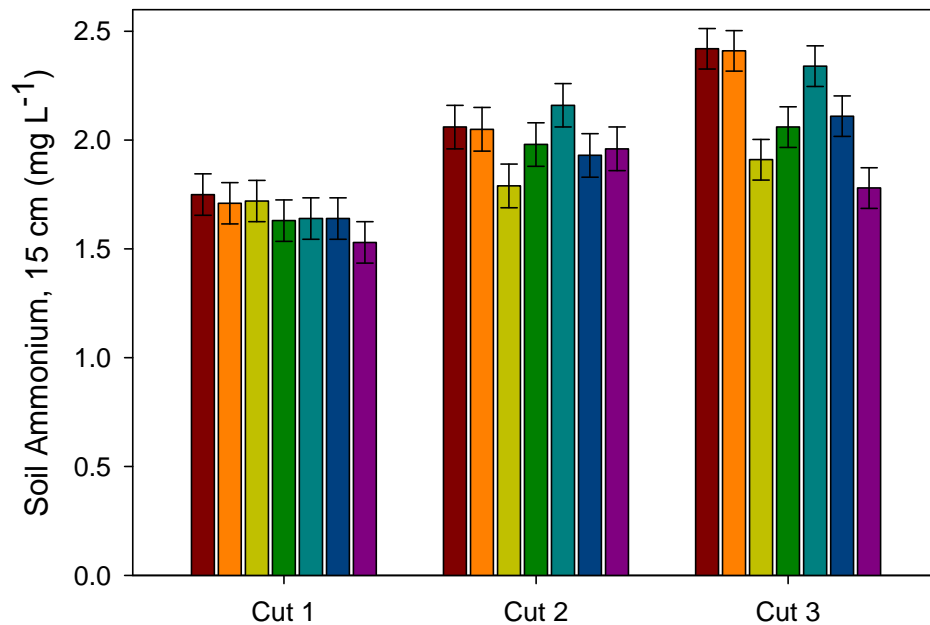
- On average % N transferred from red clover to companion bluegrass:
 - 7% early in the growing season,
 - 11% in mid summer,
 - 26% late in the summer.

Soil NO_3^- and NH_4^+

Soil NO_3^- : - No cultivar differences found in 2010 and 2011.

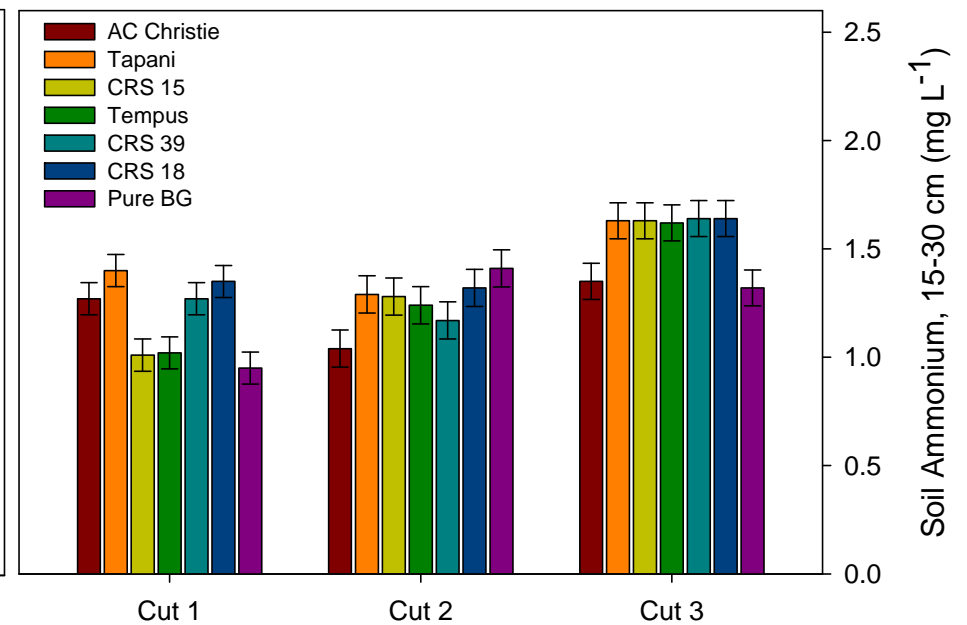
- Soil Nitrate; RC-Bg Mixed stand > Pure Bg

2011: 0-15 cm



Bg vs RC; $p=0.001$
 Cv; $p=0.041$
 C15 vs ACC, Tap; $p=0.006$

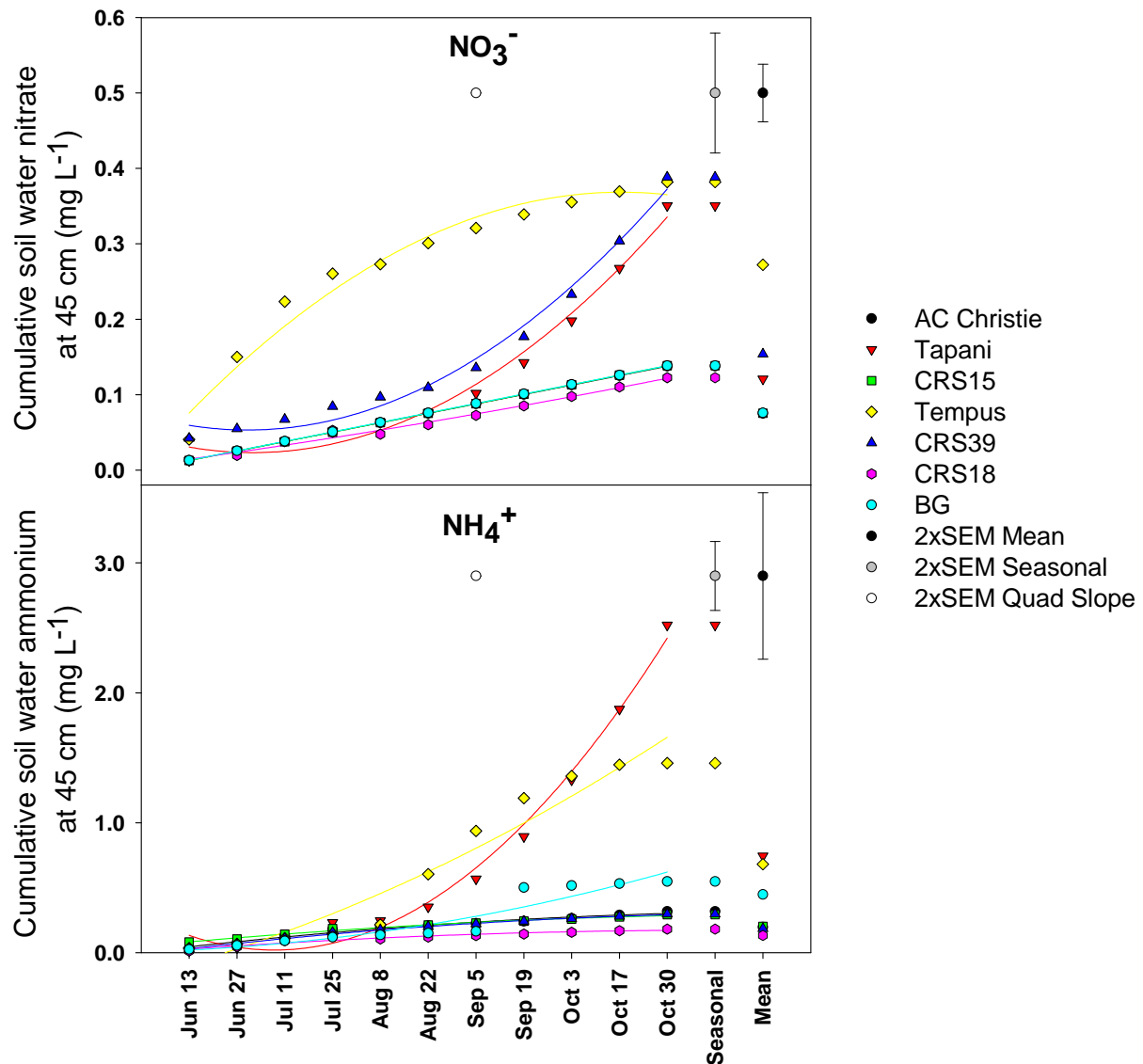
2011: 15-30 cm



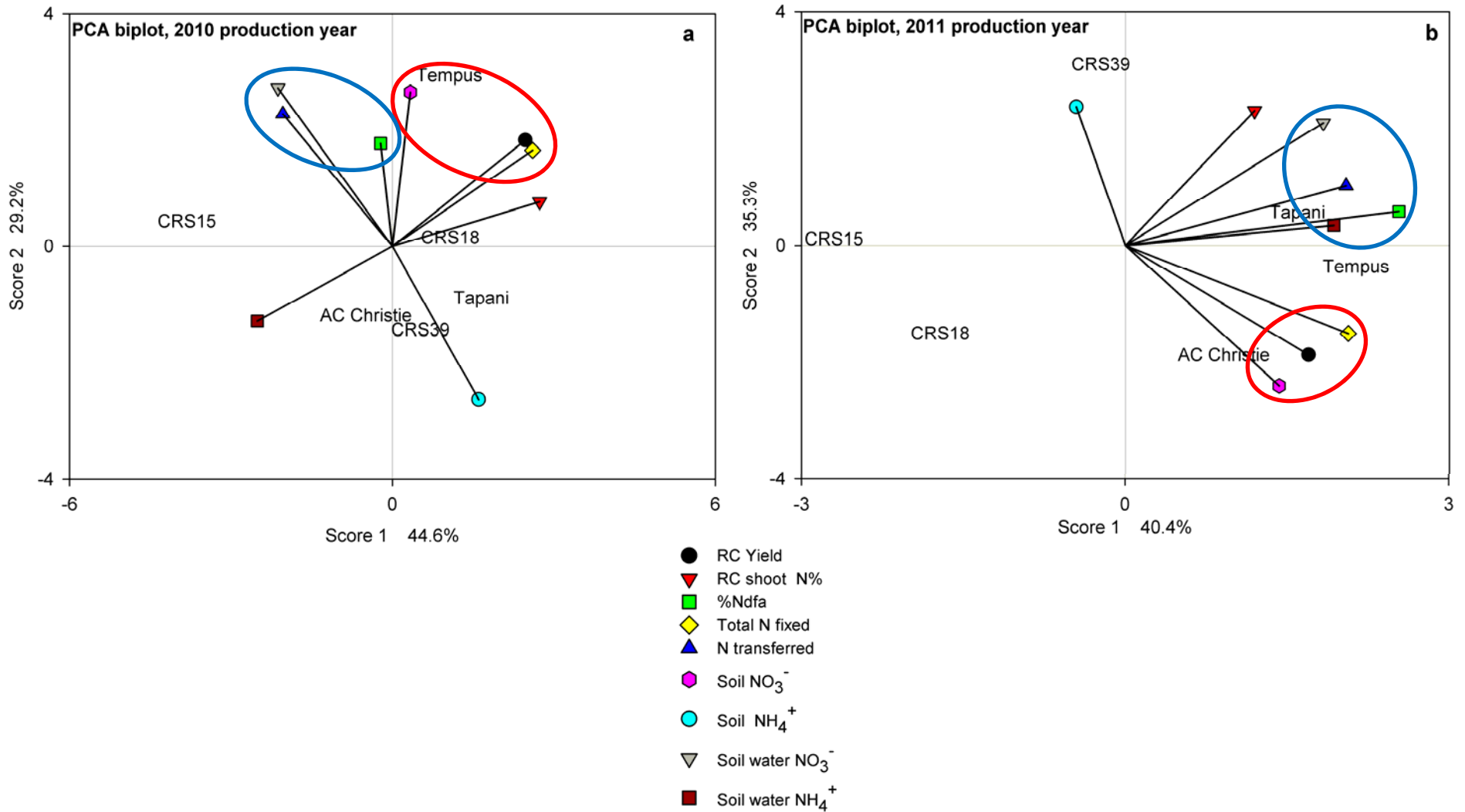
Bg vs RC; $p=0.007$
 C15 vs ACC, Tap; $p=0.002$
 Tem vs C39, C18; $p=0.041$

Bg vs RC; $p=0.015$

Potential N leaching



Principal Component Analysis



Conclusion

- All of the selected RC cultivars are efficient in N fixation under current climate and soil conditions.
- The amount of N fixation mainly driven by yield potential of the each cultivar.
- Incorporation of RC into forage mixed stands improved soil available N compared to pure stands of bluegrass.
- Evidence of genotypic variability for N transfer potential among the RC cultivars.

Conclusion

- N transfer increased as the growing season advanced.
- On average 7% (early in the growing season), 11% (in mid summer), and 26% (late in the summer) of fixed N was transferred from red clover to companion bluegrass.
- Legume genotype plays a major role in determining the amount of N transfer and N transfer pattern to neighboring non legumes.



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Thank you!

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