



# **Nitrogen deficiency-induced leaf senescence in seedlings of tropical maize cultivars as a tool to characterize grain-yielding capacity at low nitrogen supply in the field**

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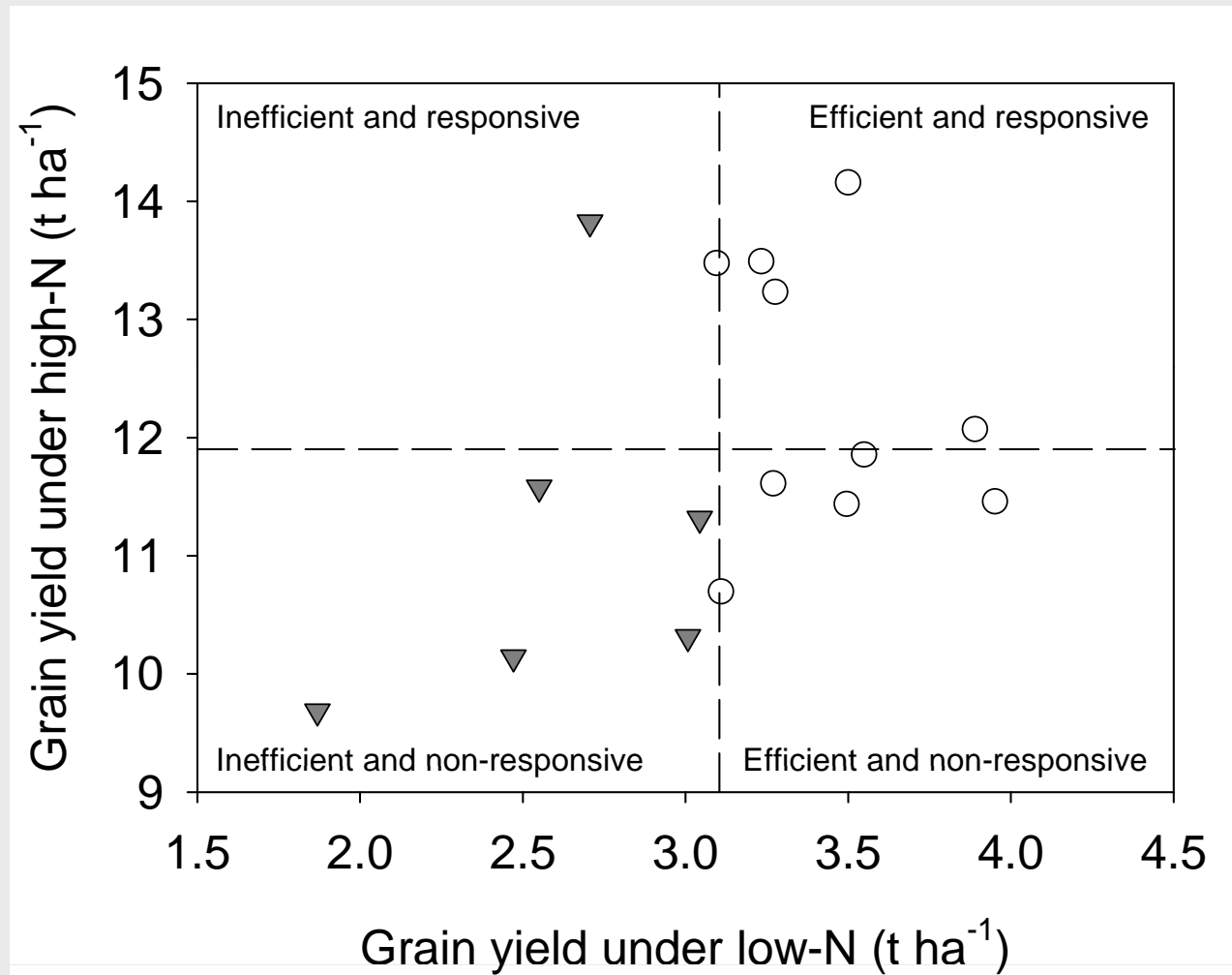
# Introduction

- Average mineral nutrient application in sub-Saharan Africa: 9 kg ha<sup>-1</sup>

(Cakmak, 2002, Plant Soil)

➔ For a sustainable agriculture, cultivars with a high yield at low-N conditions are important

# Genotypic differences in yield of tropical maize at low and high N supply. Worku et al., 2007, Crop Sci





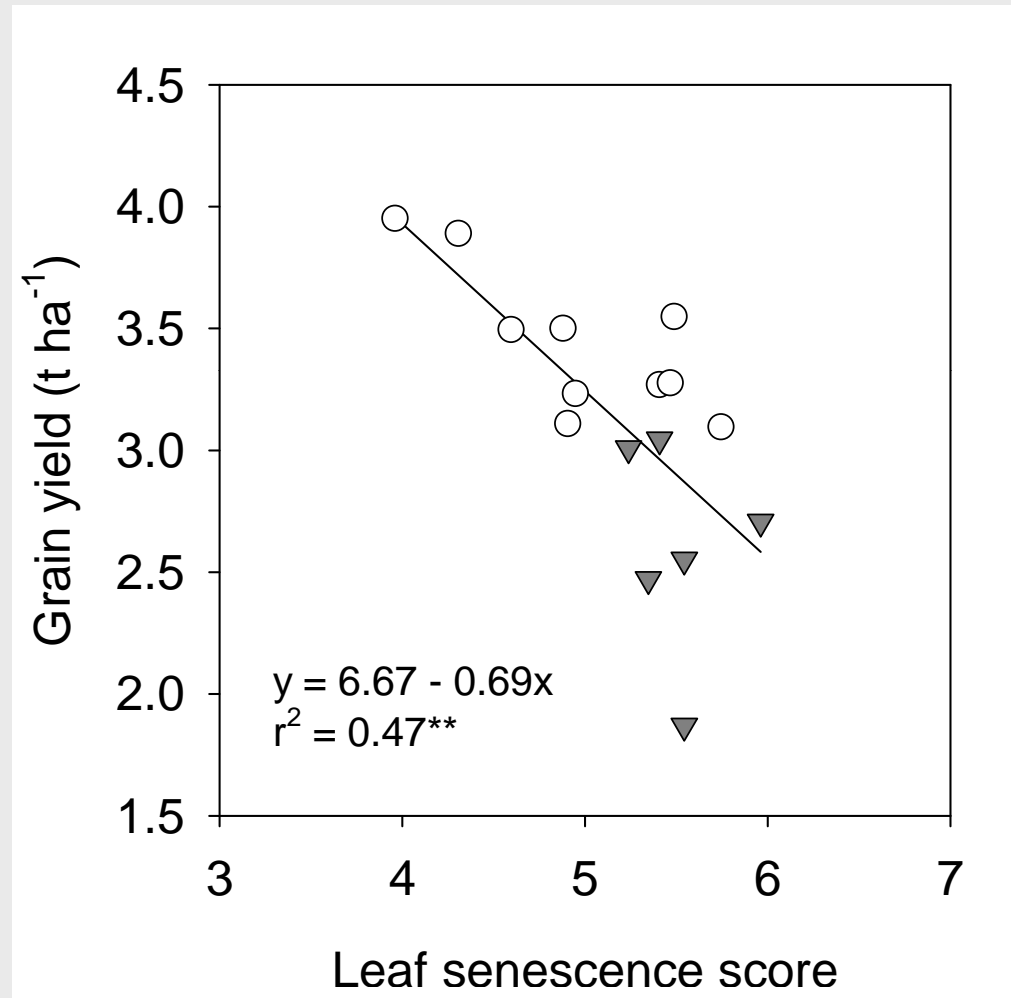
**N-efficient**



**N-inefficient**



## Leaf senescence after flowering is negatively correlated with grain yield of maize cultivars at yield-limiting N supply



Schulte auf'm Erley  
et al., 2007, JPNSS

## Coefficients of correlation between grain yield and nitrogen uptake at low and high nitrogen supply.

Field experiment in Zimbabwe 2003. from Worku et al., 2007, Crop Sci

<i>Grain yield versus:</i>	Linear correlation coefficients	
	Low N	High N
<i>N uptake</i>		
Emergence - Flowering	0.14	0.17
Flowering - Maturity	0.64**	0.14

# Hypothesis for higher N efficiency

**Delayed senescence of older leaves**



**Better assimilate supply to the roots**



**Better root growth/root activity**



**N uptake for a longer period**



**Higher grain yield**

# Coefficients of correlation between leaf senescence scores and agronomic parameters under low N supply.

Field experiments in Zimbabwe and Kenya

<i>Leaf senescence score versus:</i>	Kenya	Zimbabwe	
	2003	2003	2004
Grain yield	<b>-0.50*</b>	<b>-0.74**</b>	<b>-0.44+</b>
N uptake after anthesis	-0.28	<b>-0.67**</b>	<b>-0.46+</b>
DM accumulation after anthesis	-0.22	<b>-0.75***</b>	-0.28
Harvest index	<b>-0.63**</b>	<b>-0.61*</b>	<b>-0.49+</b>
Kernel number	<b>-0.52*</b>	<b>-0.76***</b>	<b>-0.55*</b>

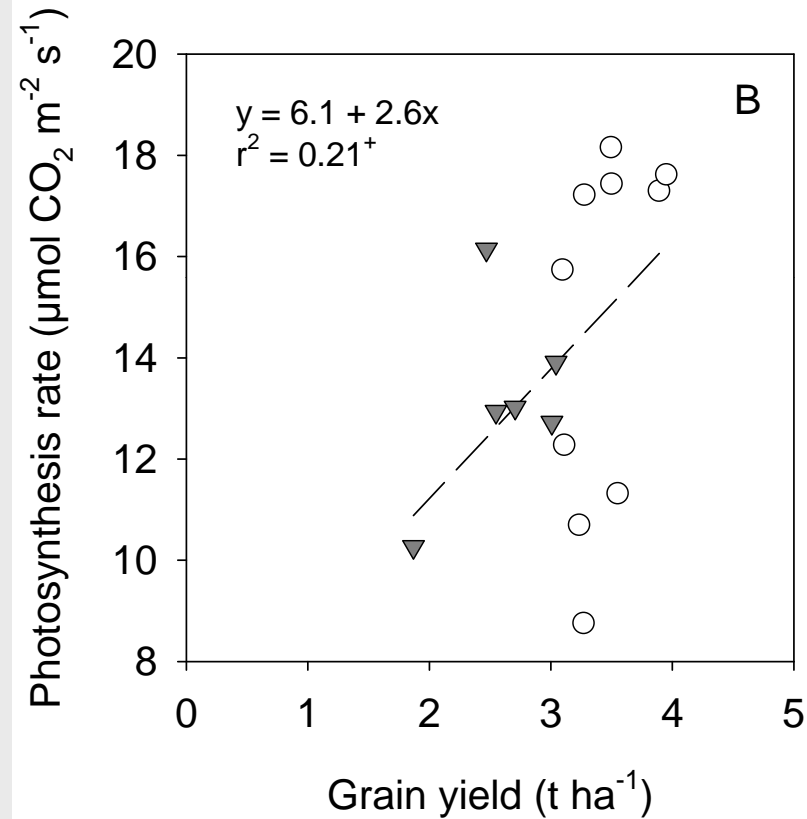
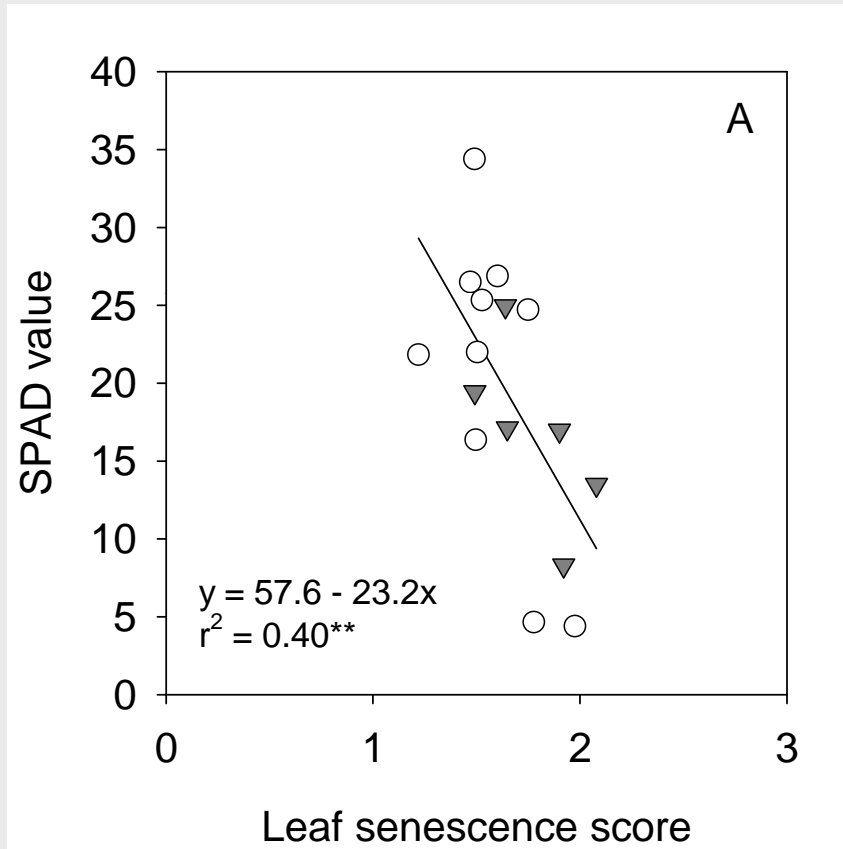
+, \*, \*\* denote level of significance at  $P < 0.1$ , 0.05 and 0.01, respectively (n = 16)



## Nutrient solution experiments

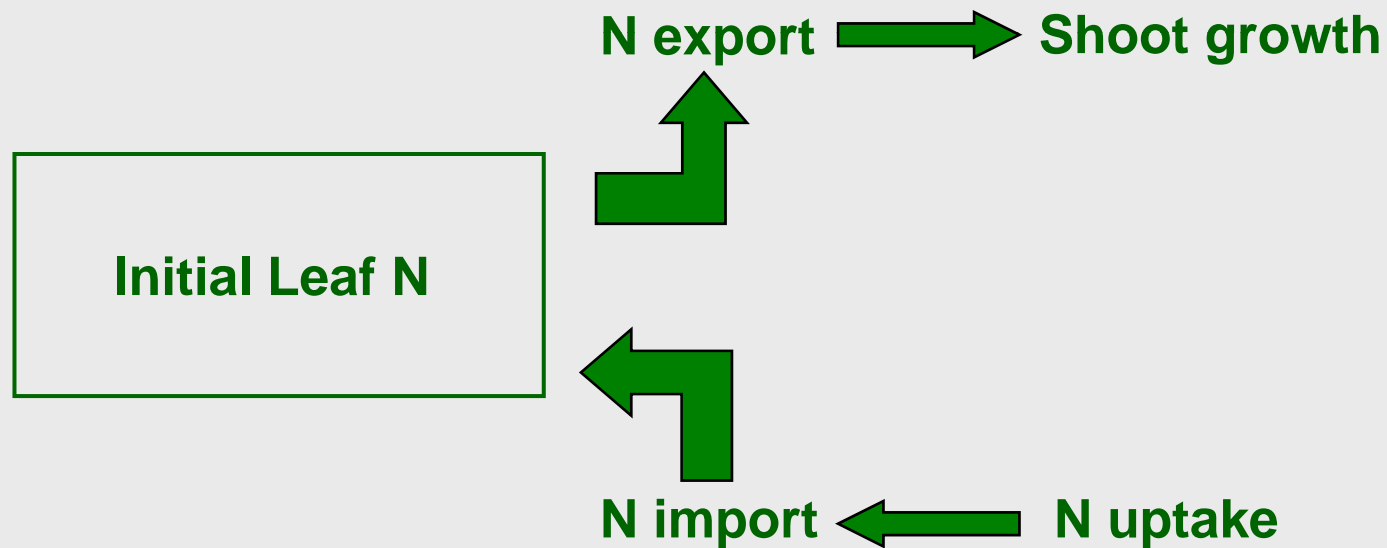
Relationship between SPAD values and photosynthesis of senescing leaves in a **nutrient solution experiment** with leaf senescence scores at anthesis and grain yield under low N stress in **field experiments** in Zimbabwe.

Schulte auf'm Erley et al., 2007, JPNSS



Field experiments

# Importance of N flows within the plant for N-deficiency induced leaf senescence in a short-term nutrient solution experiment

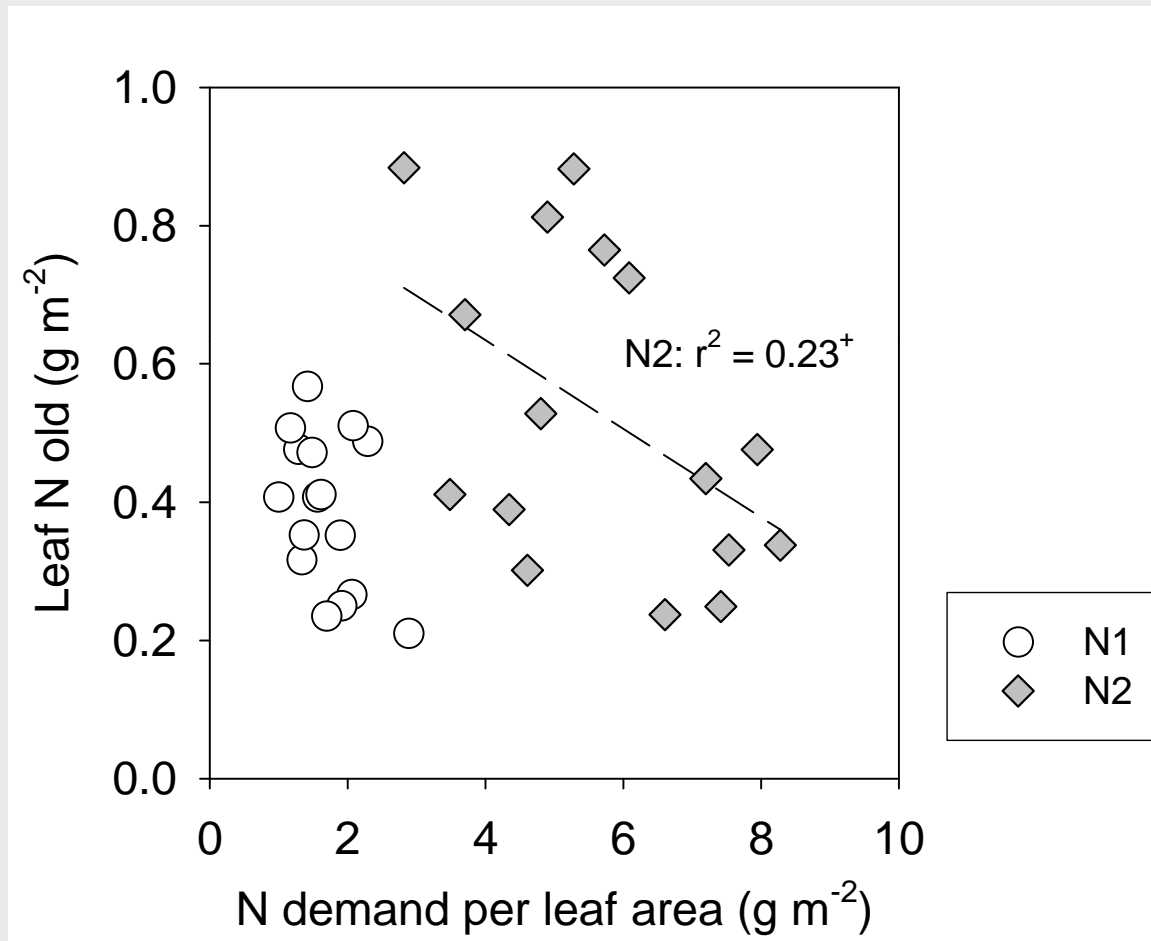


## Dissection of N import and export into senescing leaves of 16 tropical maize cultivars by <sup>15</sup>N labelling in a short-term nutrient solution experiment

N rate	Leaf N H1	N export	Leaf N old	N import	Leaf N H2
N1	0.65	0.26	0.39	0.16	0.55
N2	1.51	0.99	0.53	0.17	0.70
Cultivar	**	***	***	***	***
N rate	***	***	***	ns	**
Cult x N	ns	*	*	ns	ns

\*, \*\*, \*\*\* denote level of significance at  $P < 0.05$ ,  $0.01$  and  $0.001$ , respectively; ns denotes non significant

## A low N demand for shoot growth led to higher remaining leaf-N contents in senescing leaves ?

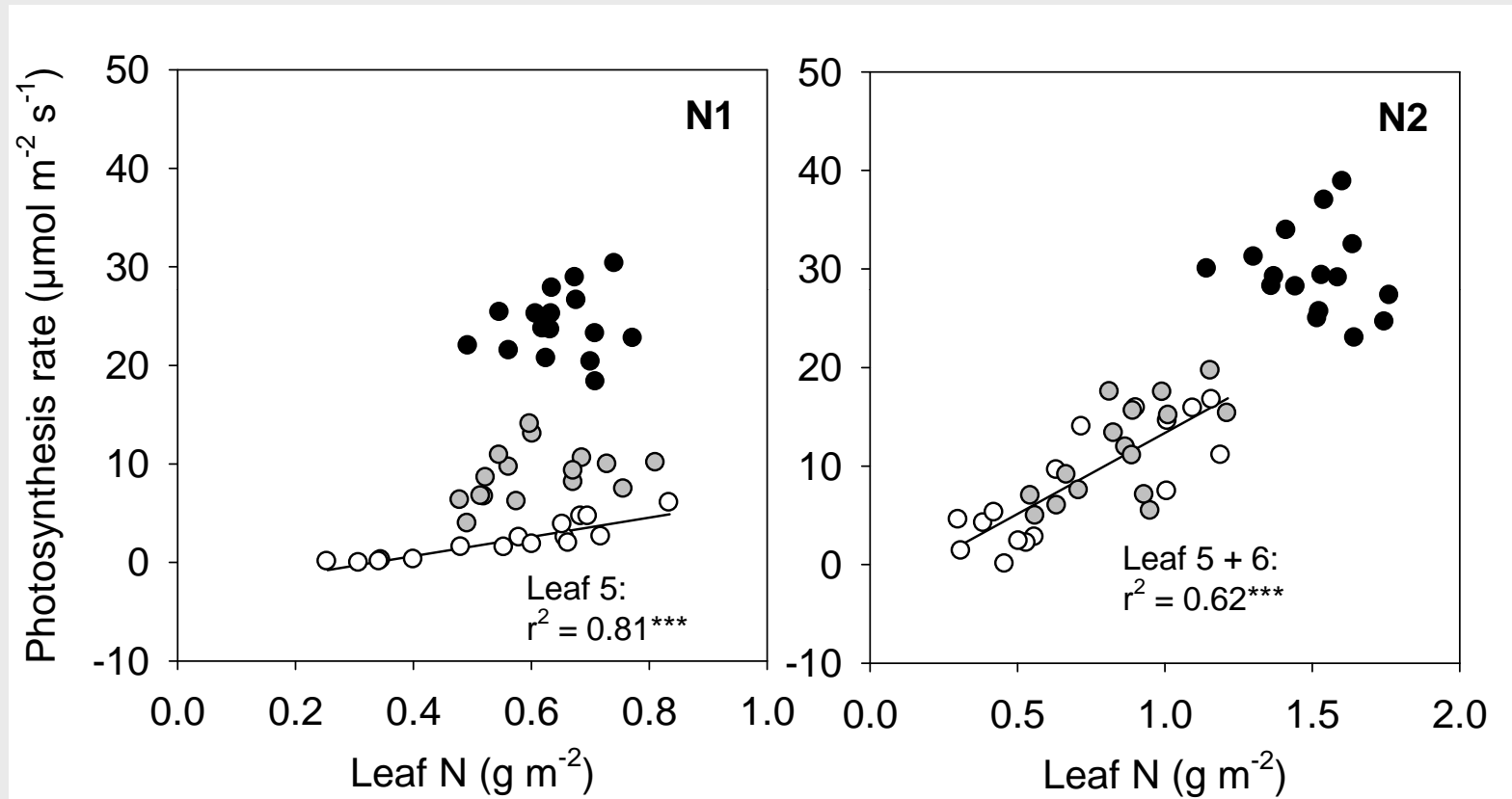


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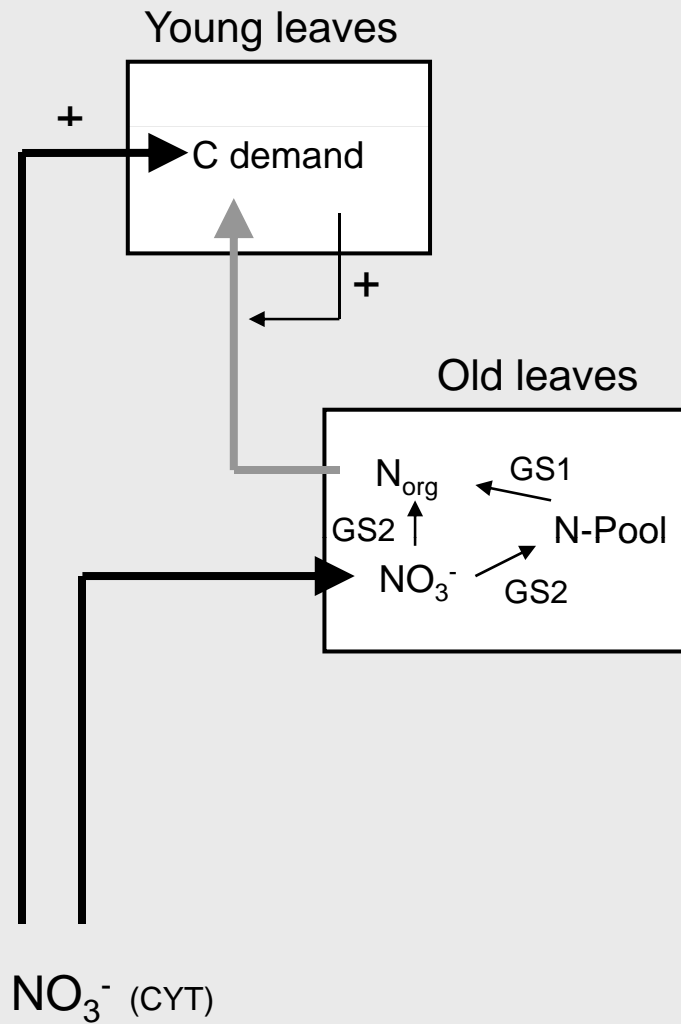
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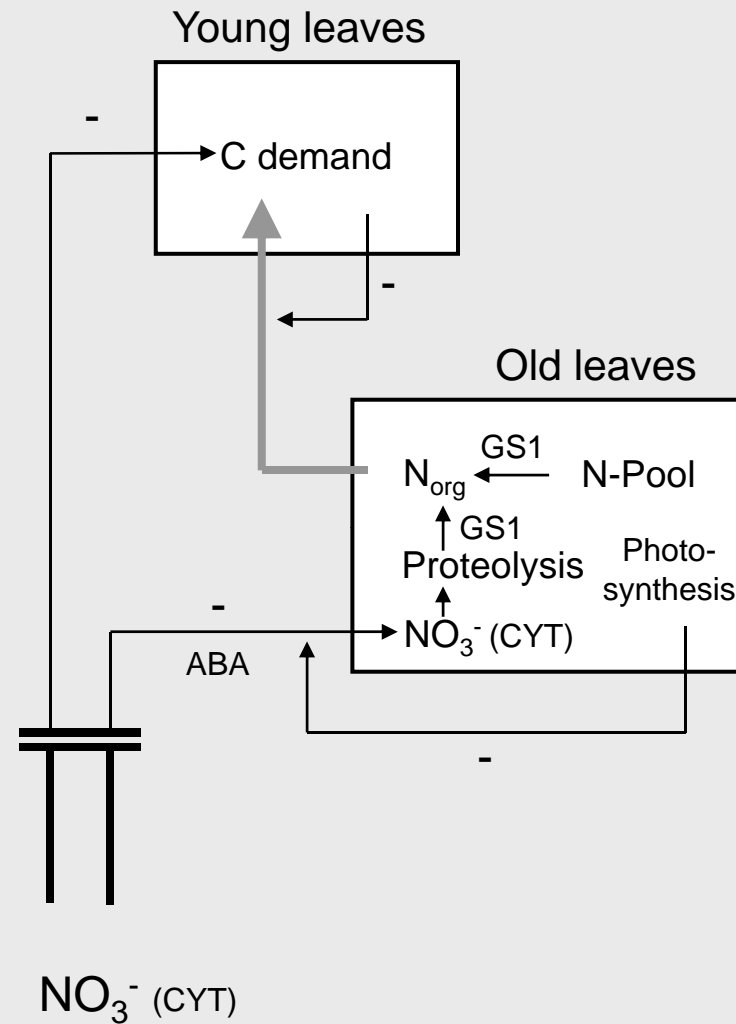
# Photosynthesis rate and leaf-N content of 16 tropical maize cultivars before and during N-deficiency induced leaf senescence



● Harvest 1, Leaf 5   ○ Harvest 2, Leaf 5   ○ Harvest 2, Leaf 6



**continuous N supply**



**N depletion**

GS: Glutamine synthetase  
 CYT: Cytokinins  
 ABA: Abcisic acid

# Conclusions

- Leaf senescence is a promising tool for a characterization of N-efficient genotypes
- Shoot N uptake in the field and plant-N flows in nutrient solution seem to have had no major influence on genotypic differences in leaf senescence
- More specific parameters for leaf senescence might be better suited to quantify genotypic differences in leaf senescence in short-term experiments

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**Thanks for your attention!**