

Rotational N recovery: What are we missing in single season estimates?



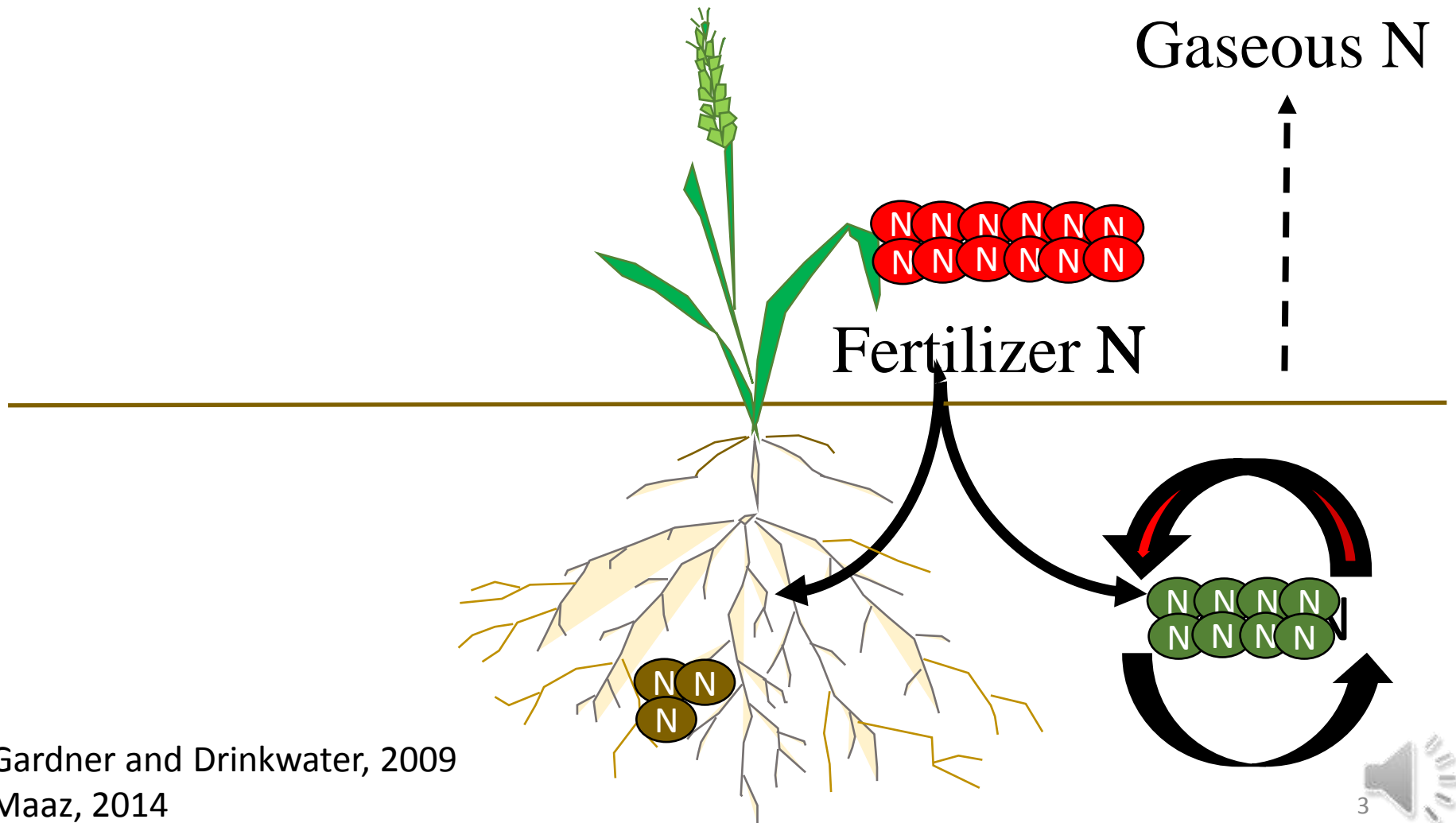
REACCH seminar
series
Tai McClellan Maaz

Global estimates for
crop recovery of N
range from 30 to 50%

Does this mean the
unrecovered N is lost????



Single season N fate



Gardner and Drinkwater, 2009
Maaz, 2014

Single season N fate

^{15}N balance (Gardner and Drinkwater, 2009)

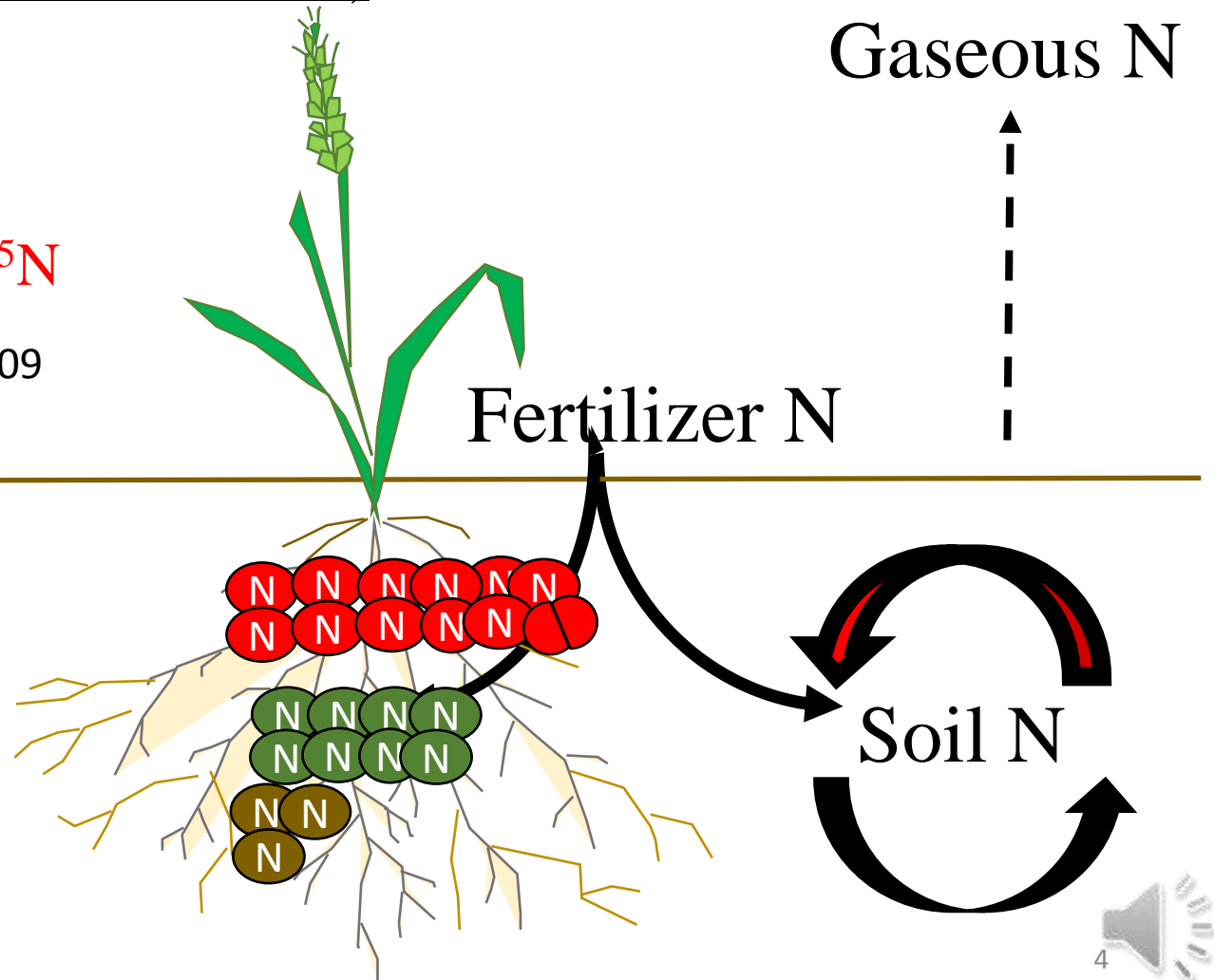
Crop = 33% ^{15}N

Grain = 21% ^{15}N

Soil = 29% ^{15}N

Unrecovered = 38% ^{15}N

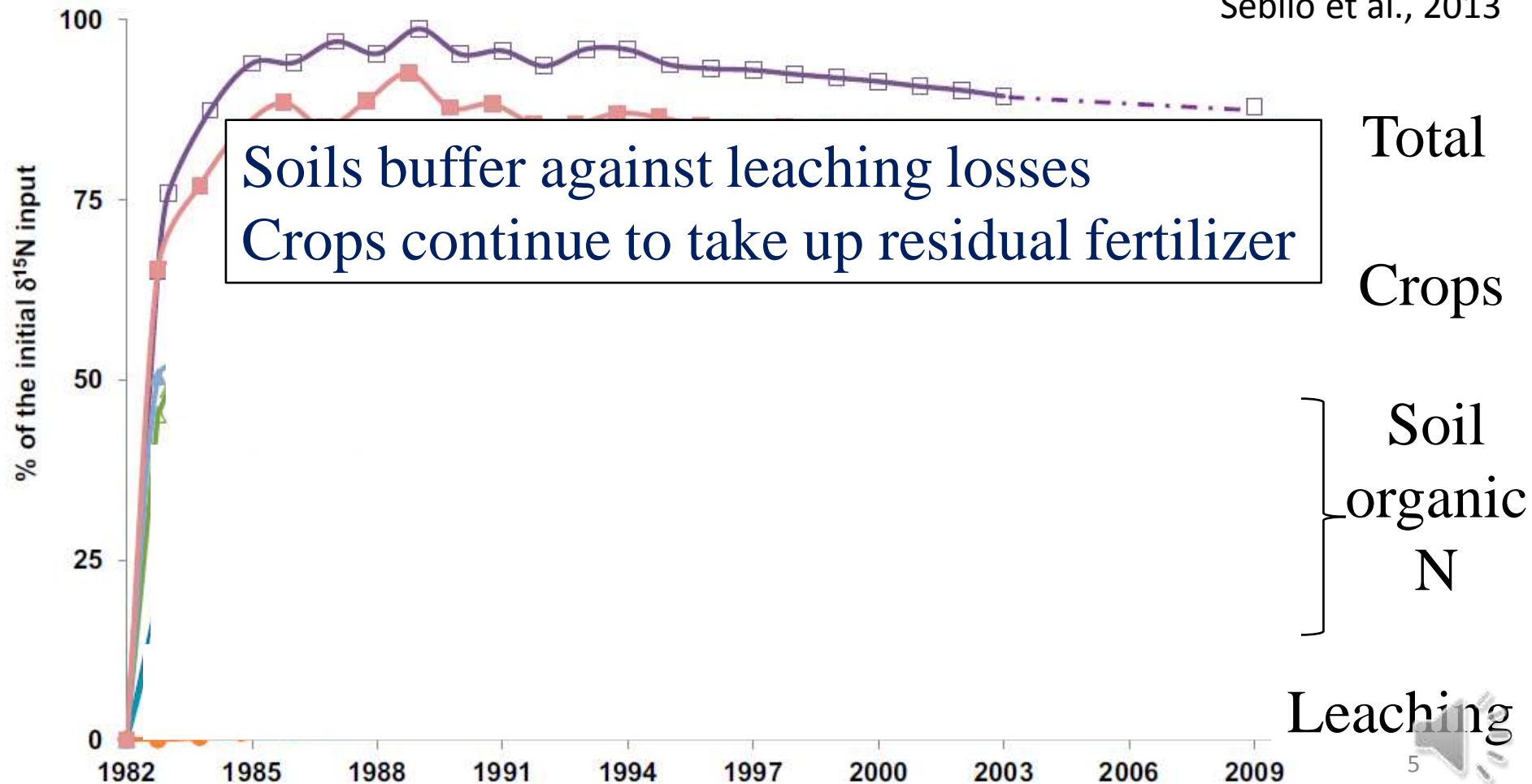
Gardner and Drinkwater, 2009



Multi-year fertilizer fate

Cumulative budget of ^{15}N -labeled fertilizer over 30 years

Sebilo et al., 2013



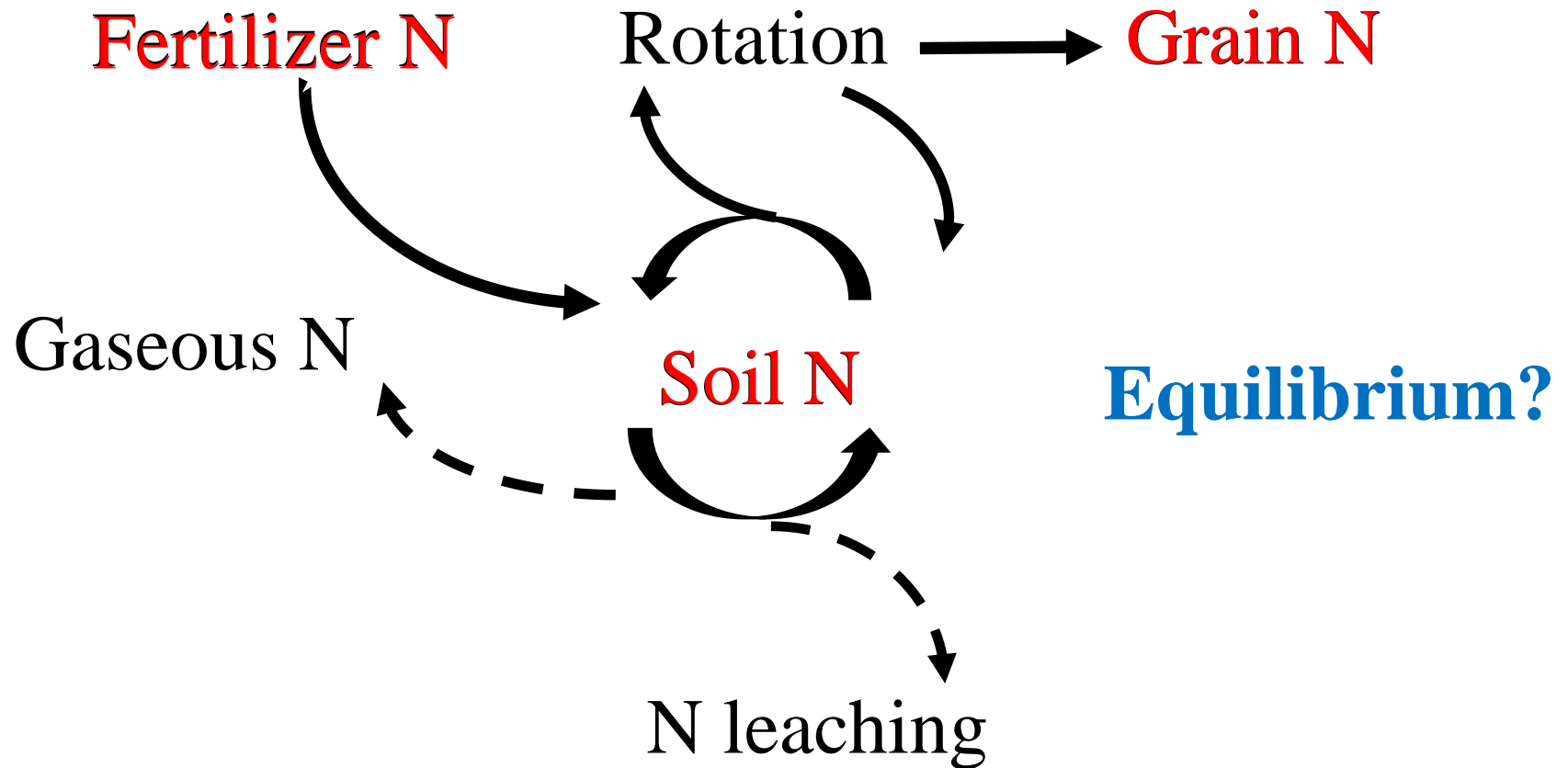
Measuring residual effects of fertilization on a cropping sequence?



How can we estimate rotational N
recovery to compare cropping
systems?



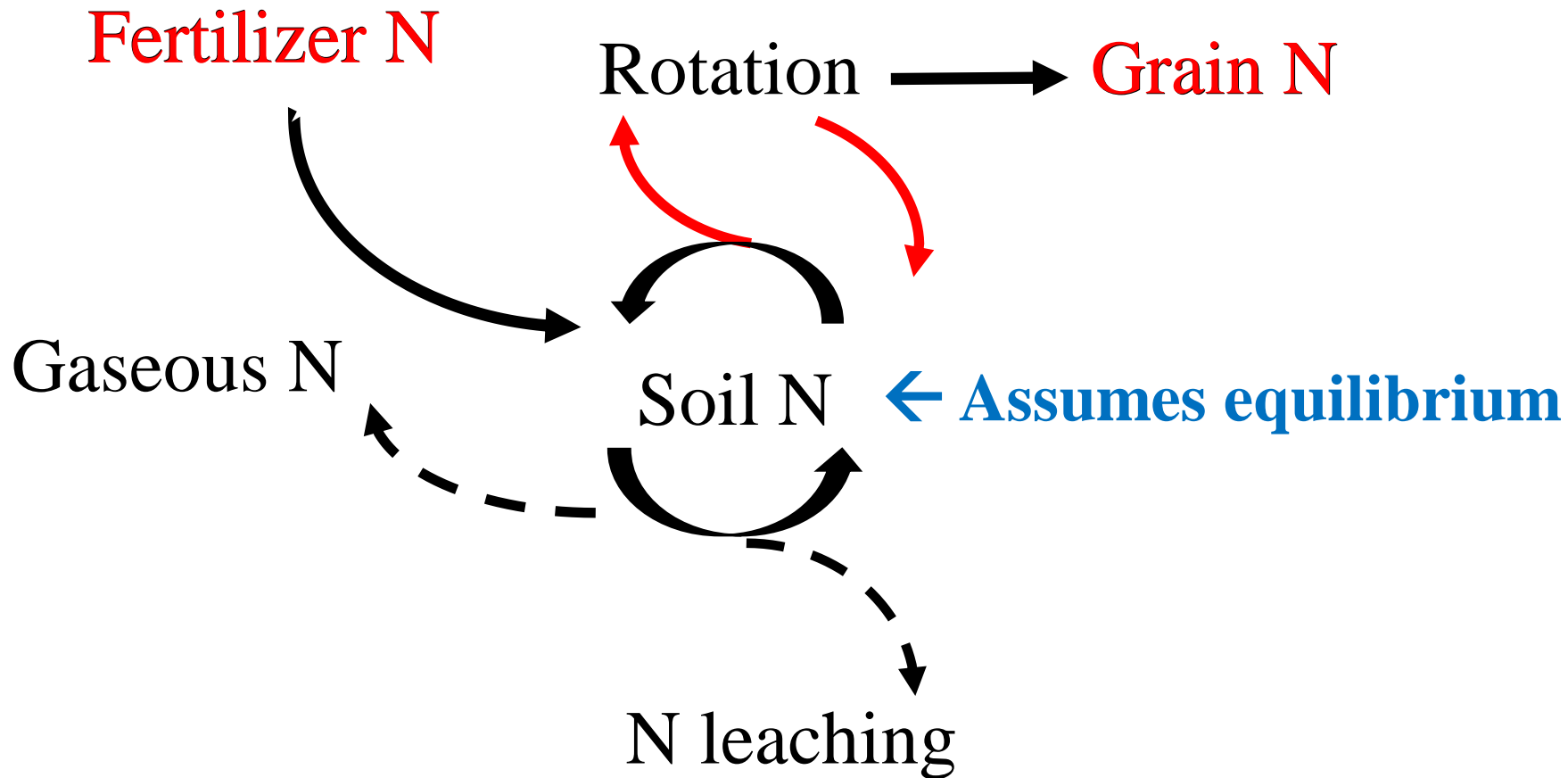
Total N balance approach



$$\left(\frac{\text{Total harvested grain N} + (\text{Soil N 2008} - \text{Soil N 1998})}{\text{Total applied fertilizer N}} \right)$$



Modified multi-year N balances



$$\left(\frac{\text{Total grain N} + \text{Final root zone } N_{\text{inorganic}}}{\text{Total applied fertilizer N} + \text{Initial } N_{\text{inorganic}}} \right)$$

Ralston (Wheat-fallow)

1996-2000	Inputs	Outputs	Balance		Missing N
Cropping sequence	N_{fert}	Grain N	Grain	Grain+ Soil	
	lb ac ⁻¹		*	**	lb ac ⁻¹
WW-F	200	171	0.85	0.81	51
SW-Chem Fallow	204	147	0.72	0.82	53
Cont. NT HRS-SB	396	277	0.70	0.76	113
Cont. NT HRS	495	304	0.61	0.64	131

* Grain N balance = $\text{Grain N} / N_{\text{fert}}$

** Total N balance = $(\text{Grain N} + \text{Final Root Zone Inorganic N}) / (N_{\text{fert}} + \text{Initial Soil Inorganic N})$



Conclusions

1. Multi-season approach
 - a) Soil N is a major contributor of plant N
 - b) Accounts for differences in N recycling and retention from year to year
 - c) **Need to monitor soil organic N**
2. Rotational estimates vs single season
 - a) Exceed, if increases in N storage
 - b) Equal to, if no change in N storage
 - c) Less than, if decreases in N storage

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