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Reactive Nitrogen Management for Sustainable Development - Science, Technology and Policy

Best management practices to improve fertilizer N use efficiency in Argentinean agriculture

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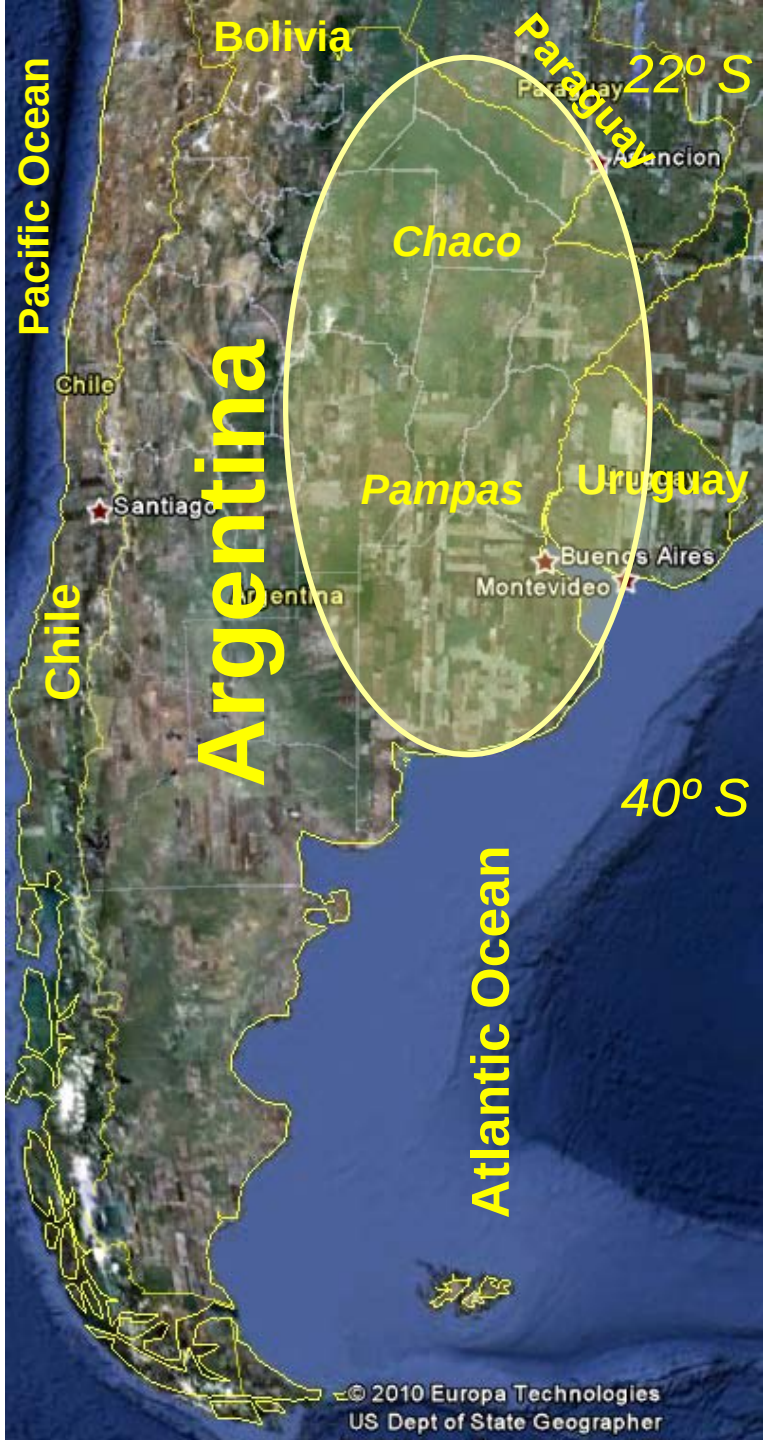

Grain production in Argentina

- Approximately 90% of grain crops harvested area is located in the Pampas-Chaco region, in the east-central plains of Argentina.

- Soils of the Pampas are deficient in nitrogen (N), phosphorus (P), and sulfur (S).

- 65% of the cropping area is under no-tillage

- Approximately 50% of the total cropped land is under annual leasing conditions

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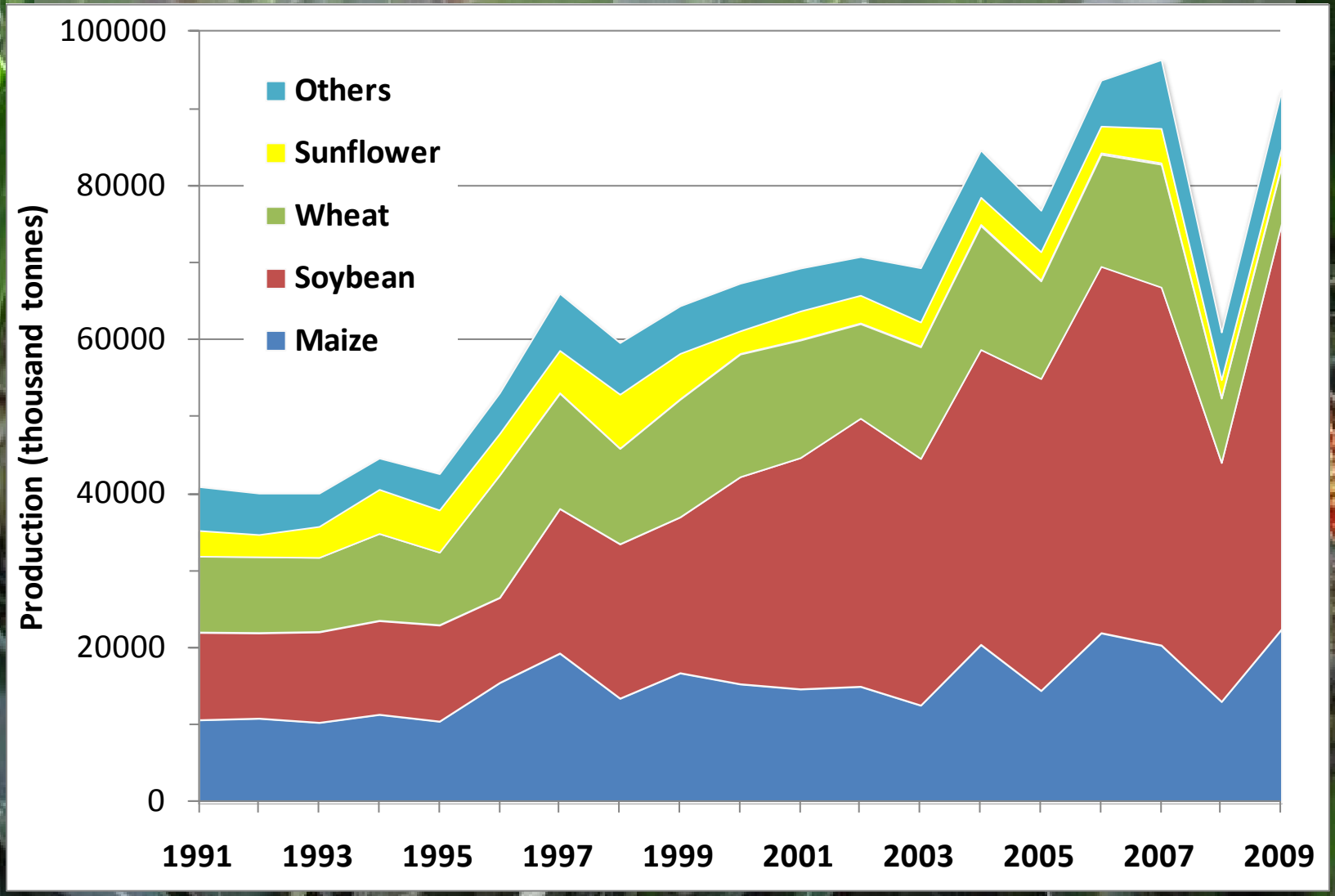
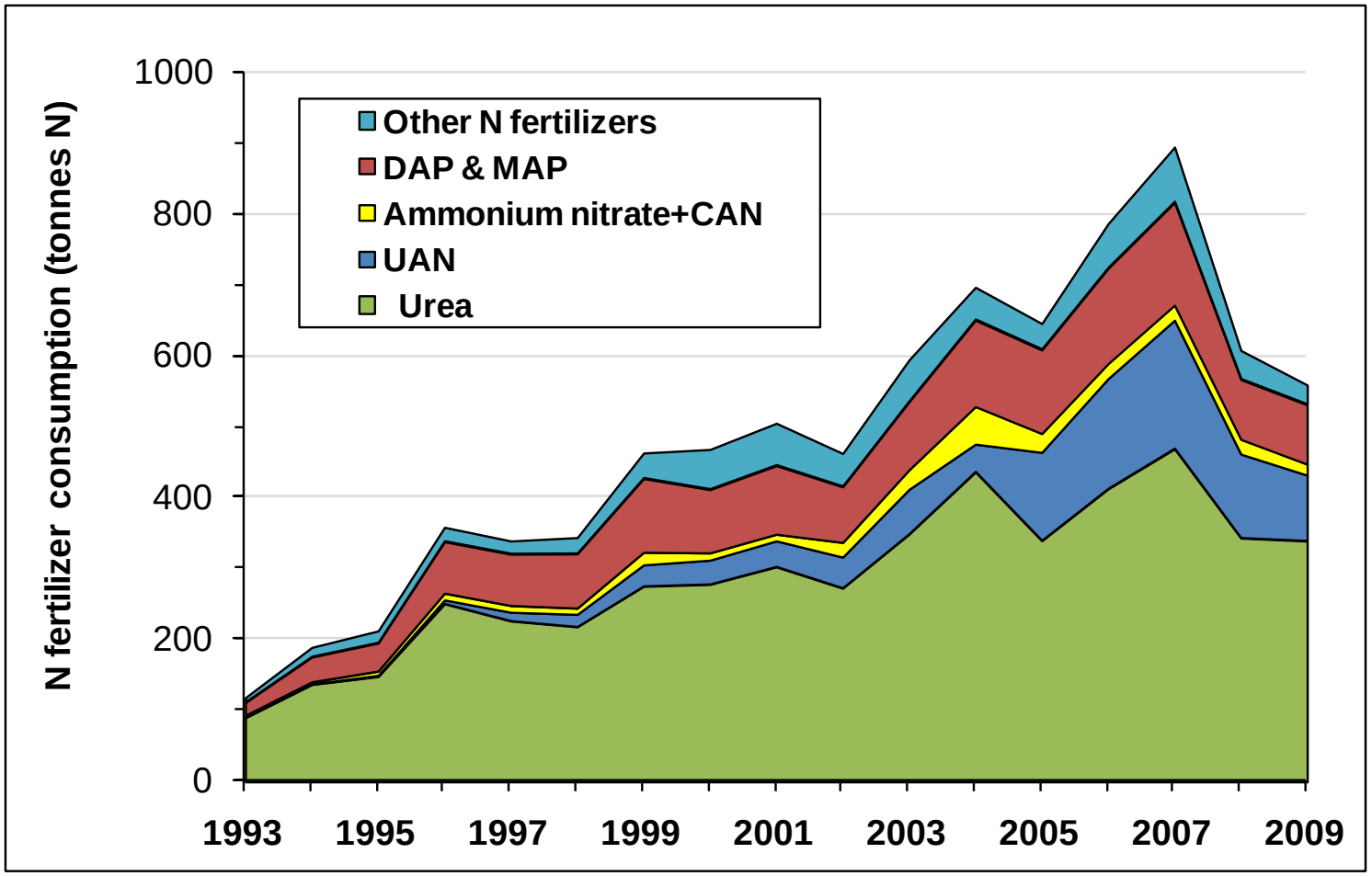
Field crops at Argentina Production from 1990 to 2009



Elaborated from information of MinAgri

N fertilizer consumption in Argentina 1993-2009



Source: MinAgri and Fertilizar AC

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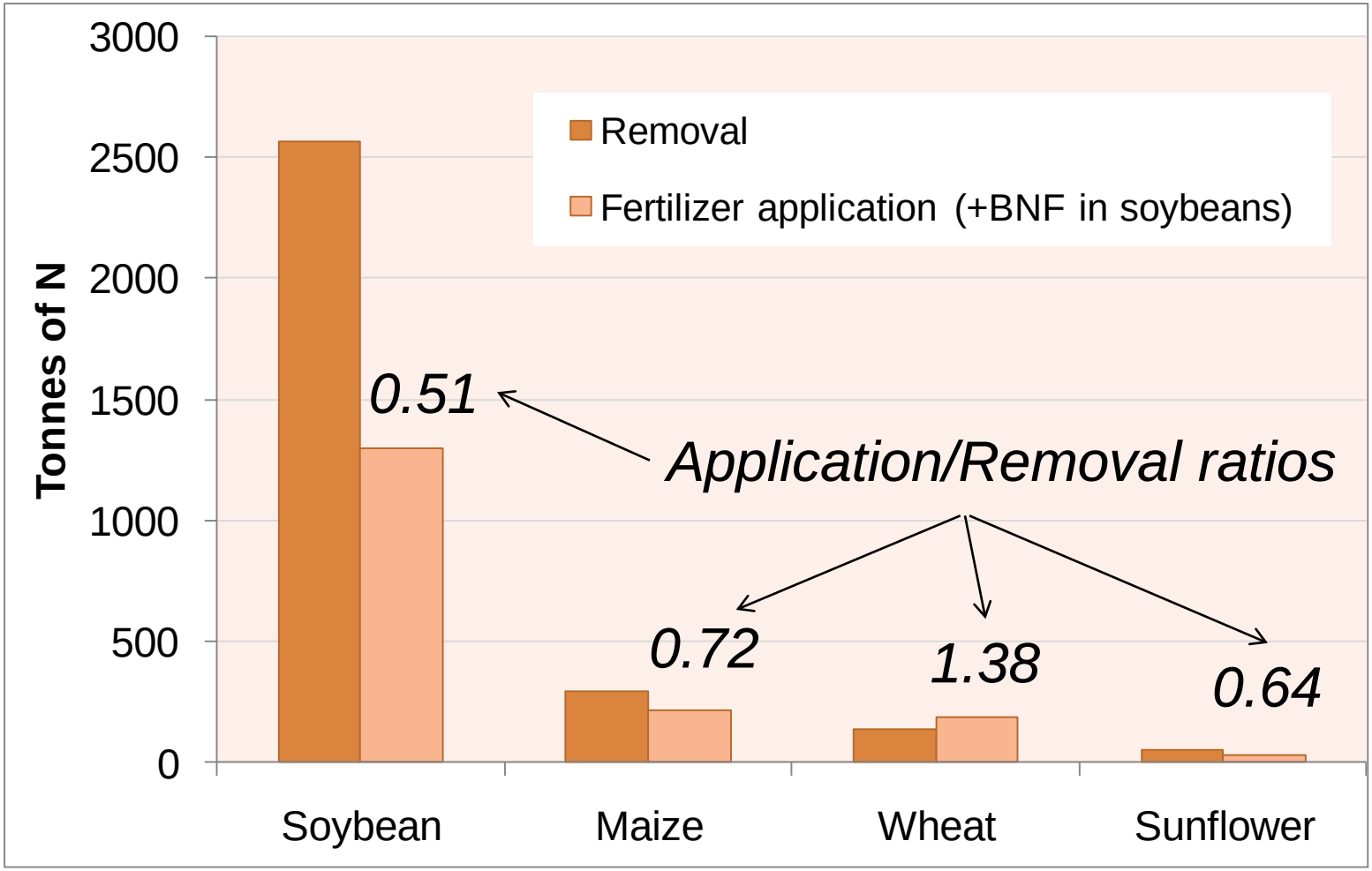
N Balance by Crop
Argentina 2009/10



Fate of N fertilizer applied to wheat and maize crops in the Pampas region of Argentina

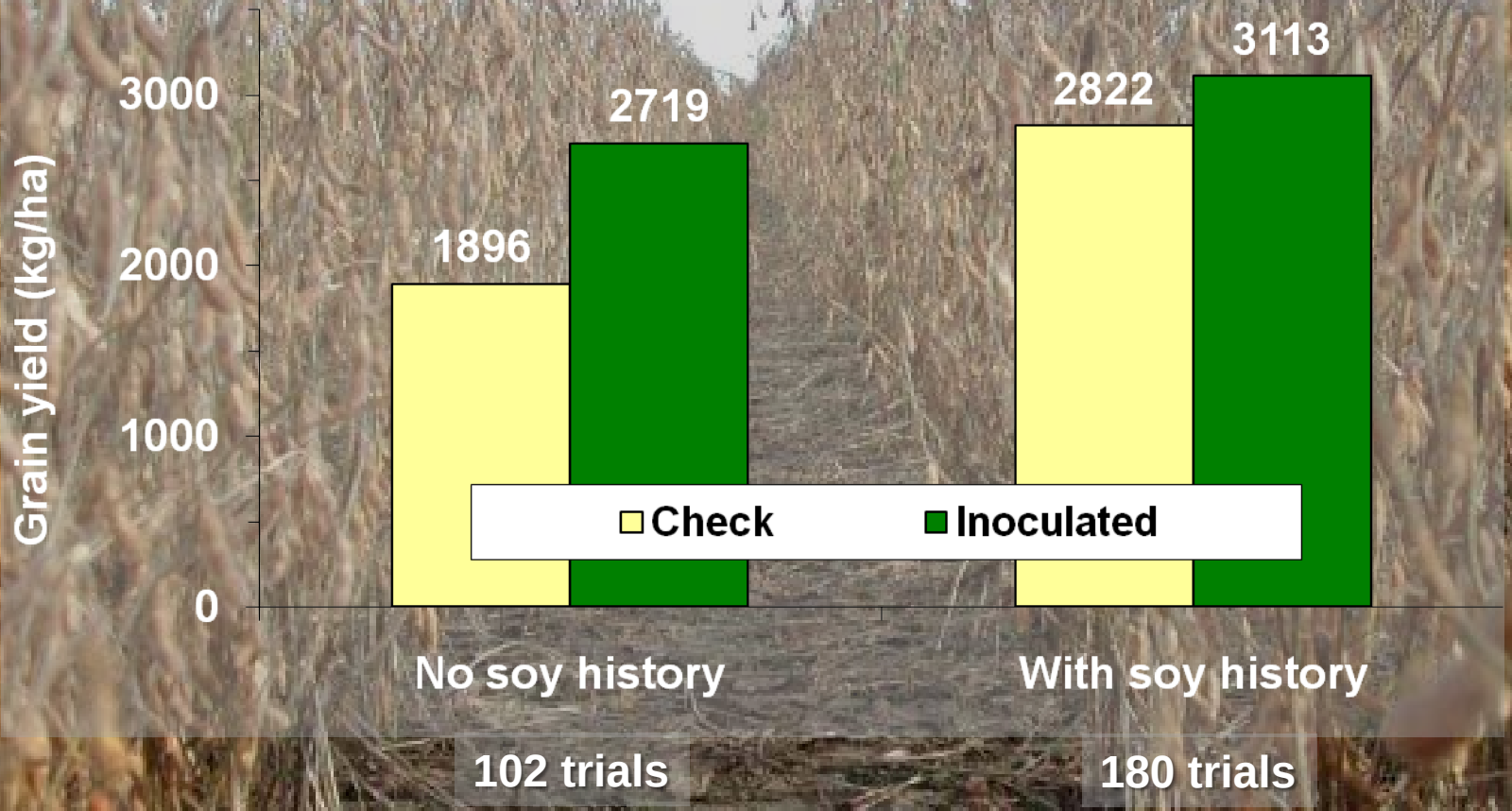
Sink	Range	*References*
Plant	35 to 80%	*Melaj et al. 2003; Portela et al. 2006; Rillo and Richmond 2006; Rimski-Korsakov et al. 2008*
Organic matter	7 to 29%	*Sainz Rozas et al. 2004; Portela et al. 2006 ; Rimski-Korsakov et al. 2008;*
Volatilization	1.1 to 30%	*Videla et al., 1996; Garcia et al. 1999; Sainz Rozas et al. 2004; Rimski-Korsakov et al. 2007a*
Denitrification	0.13 to 6.9%	*Palma et al. 1997; Picone et al. 1997; Sainz Rosas et al. 2001; Ciampitti et al. 2008*
Leaching	<0.01 to 23%	*Sainz Rozas, et al. 2004; Portela et al. 2006 ; Aparicio et al. 2008*

Adapted from Lavado et al. (2007)

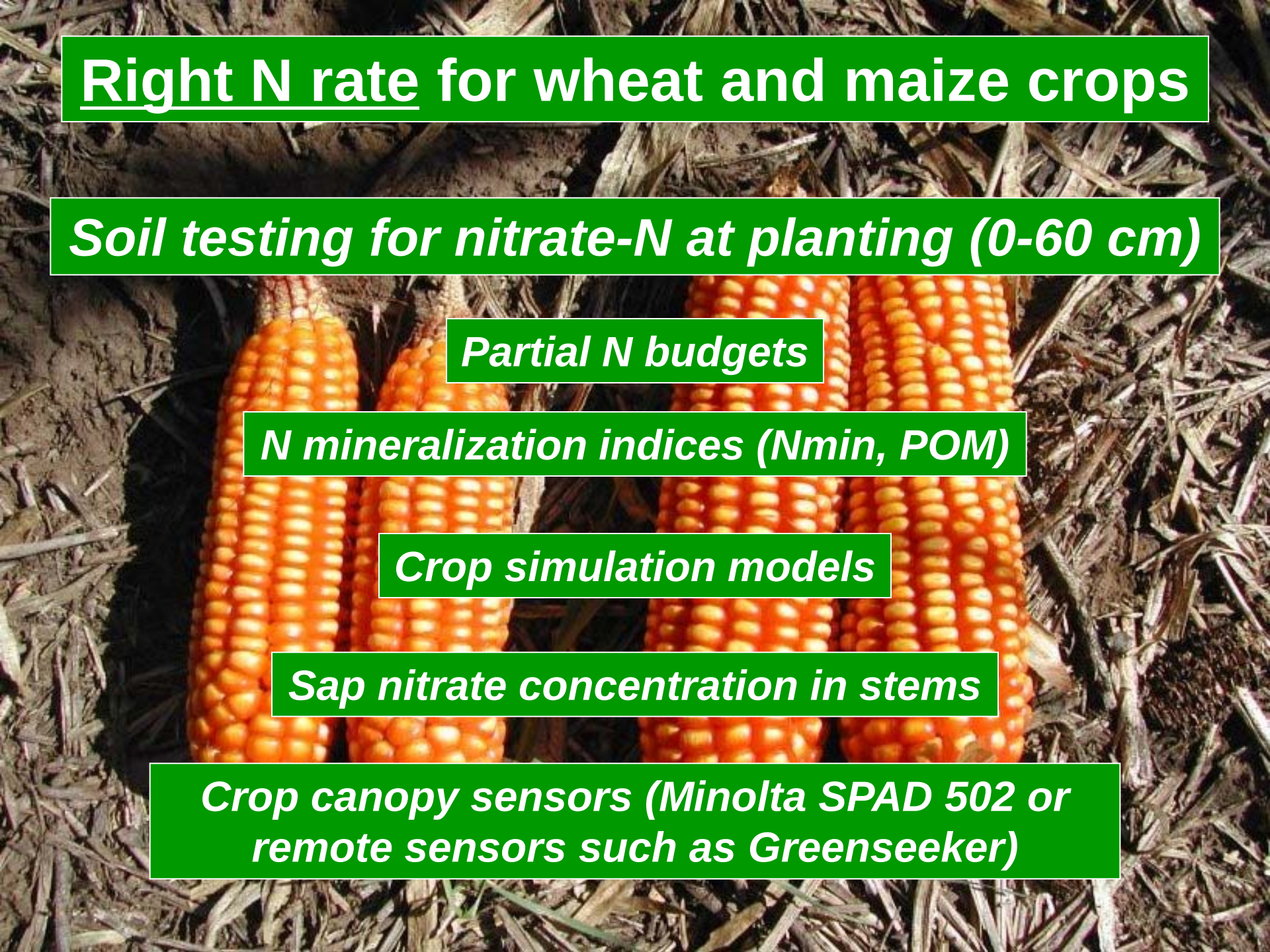
Soybean inoculation

A. Perticari - INTA Inocular

1994-2004



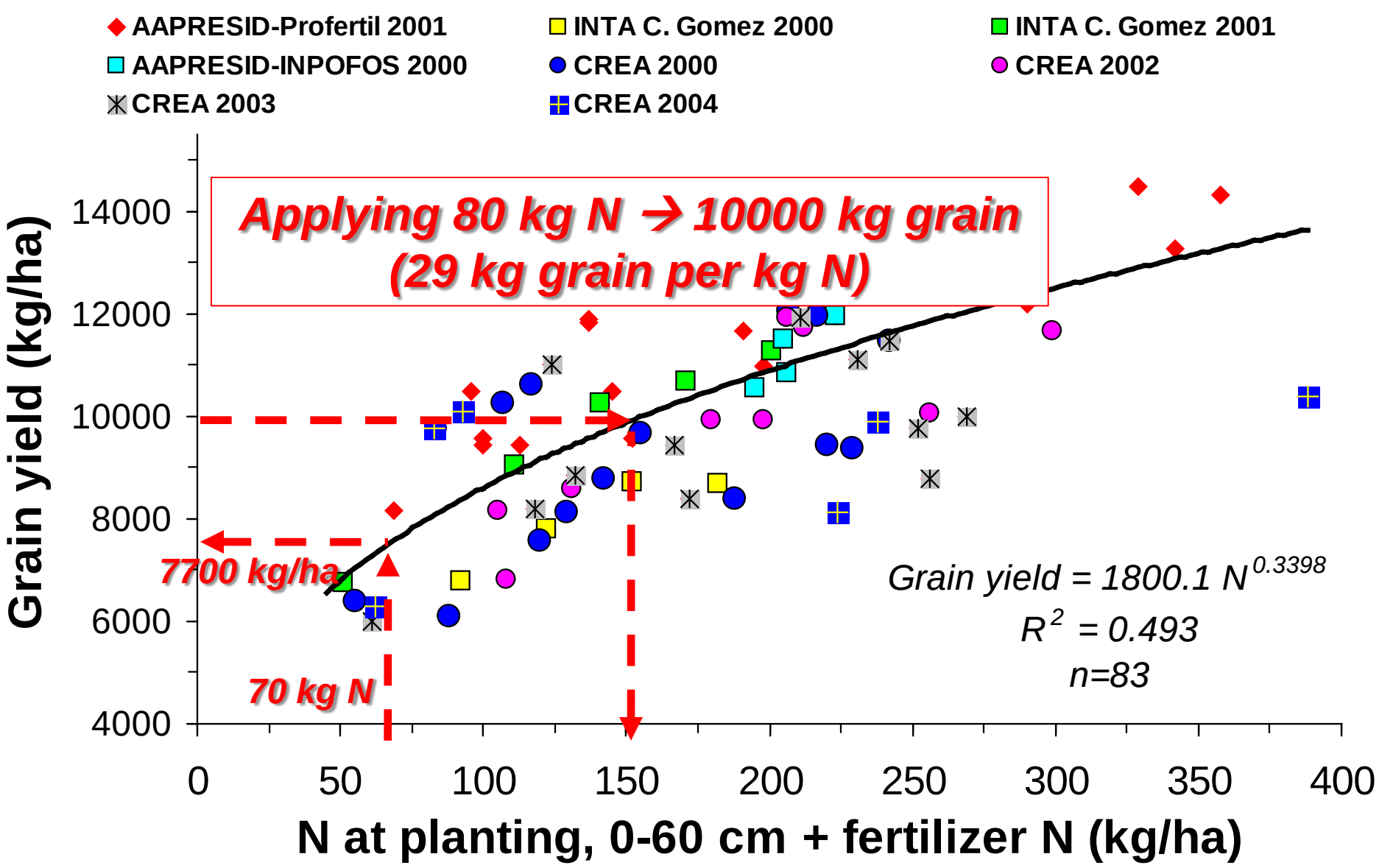
Biological N fixation provides up to 75% of the N accumulated by the crop


Right N rate for wheat and maize crops
Soil testing for nitrate-N at planting (0-60 cm)
Partial N budgets
N mineralization indices (Nmin, POM)
Crop simulation models
Sap nitrate concentration in stems
Crop canopy sensors (Minolta SPAD 502 or remote sensors such as Greenseeker)

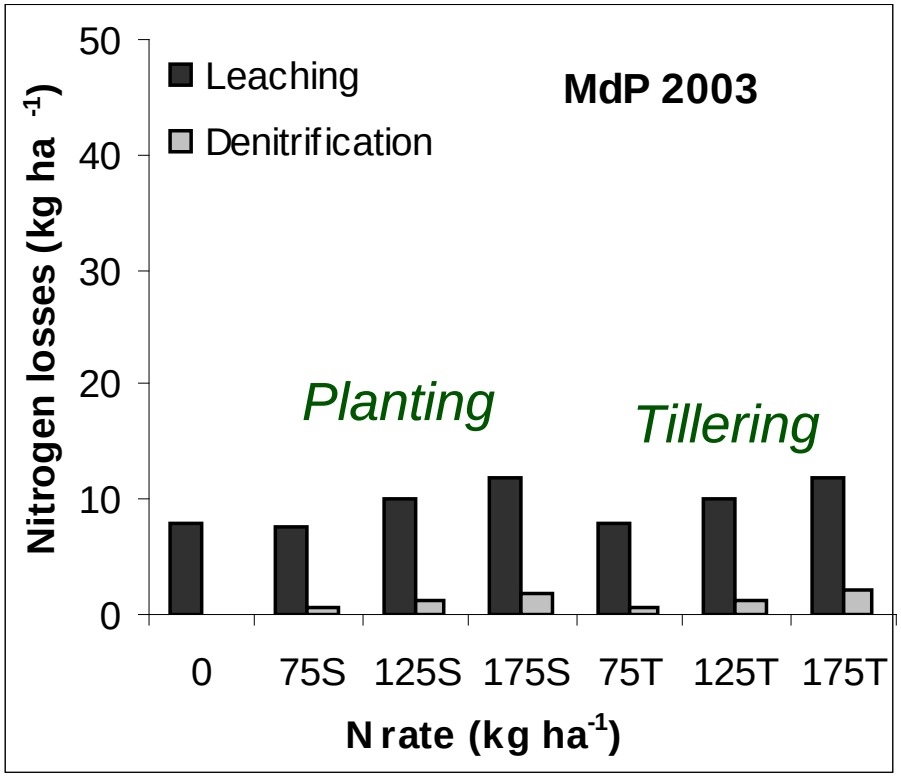
Critical levels of available N at planting (NO_3^--N, 0-60 cm depth) for wheat and maize in different areas of the Pampas with different expected yields

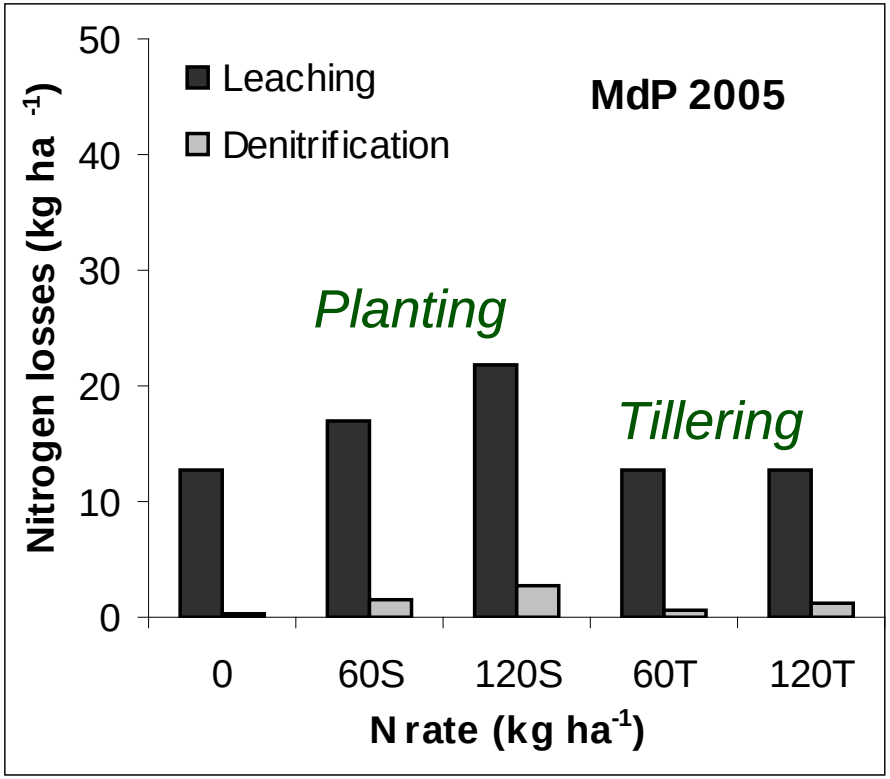
Area	Critical level (NO_3^--N, 0-60 cm + fertilizer)	Expected yield	Reference
	---------- kg ha^{-1} ----------		
Wheat			
SE Buenos Aires	125	3500	González Montaner et al., 1991
SE Buenos Aires	175	5000-5500	González Montaner et al., 2003
Central and South Santa Fe	92	3500-4000	Salvagiotti et al., 2004b
Southern Santa Fe and Córdoba	100-150	3200-4400	García et al., 2006
Maize			
Northern Buenos Aires	150	9000	Ruiz et al., 2001
Northern Buenos Aires	150-170	10000	Alvarez et al., 2003
Central and South Santa Fe	135 162	< 9500 > 9500	Salvagiotti et al., 2004c
Southern Santa Fe and Córdoba	150-200	10000-11000	García et al., 2006

Available N at planting and maize grain yield



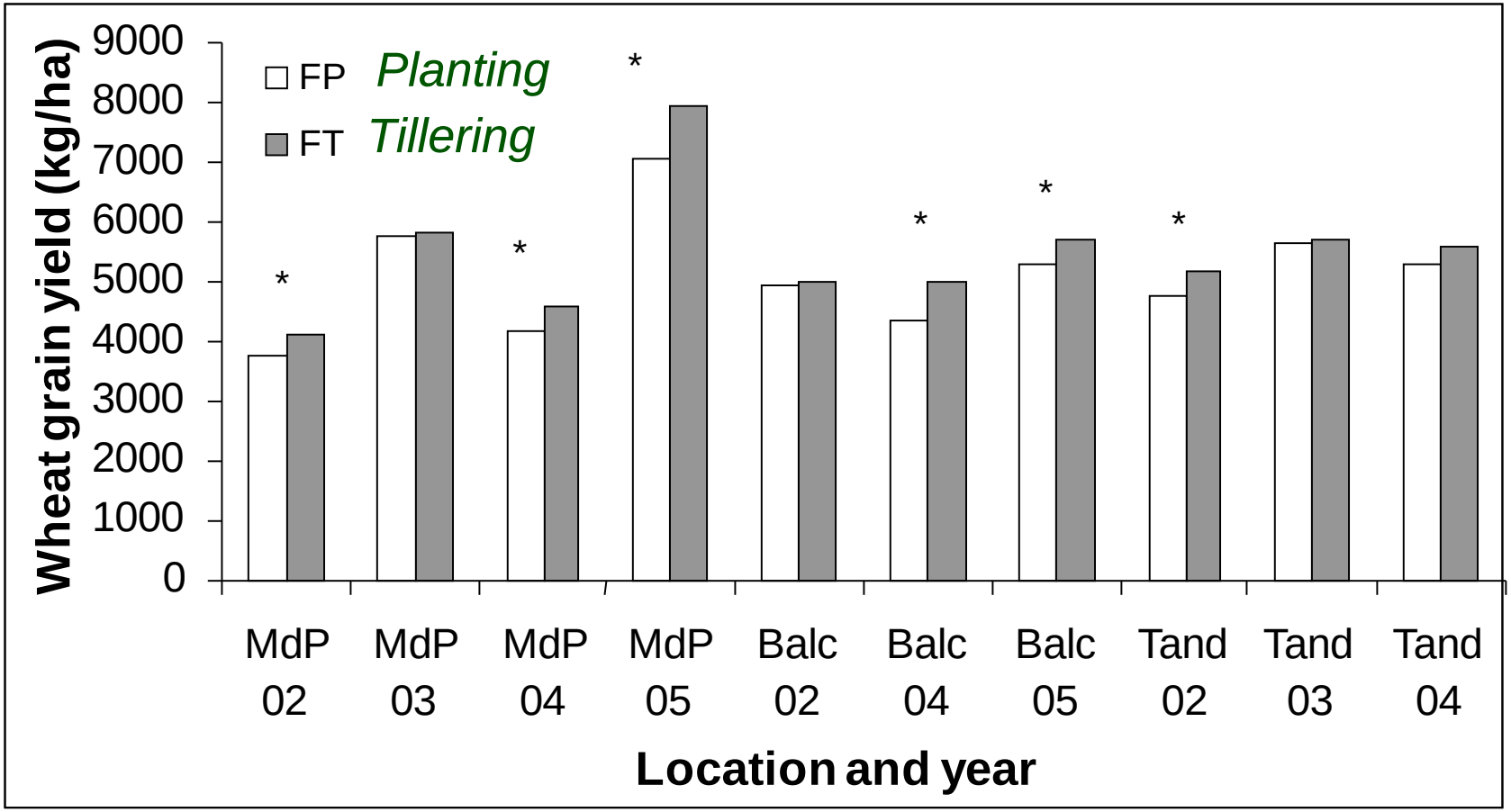
Right time: N losses by leaching and denitrification for two different application times in wheat





Barbieri et al., 2008

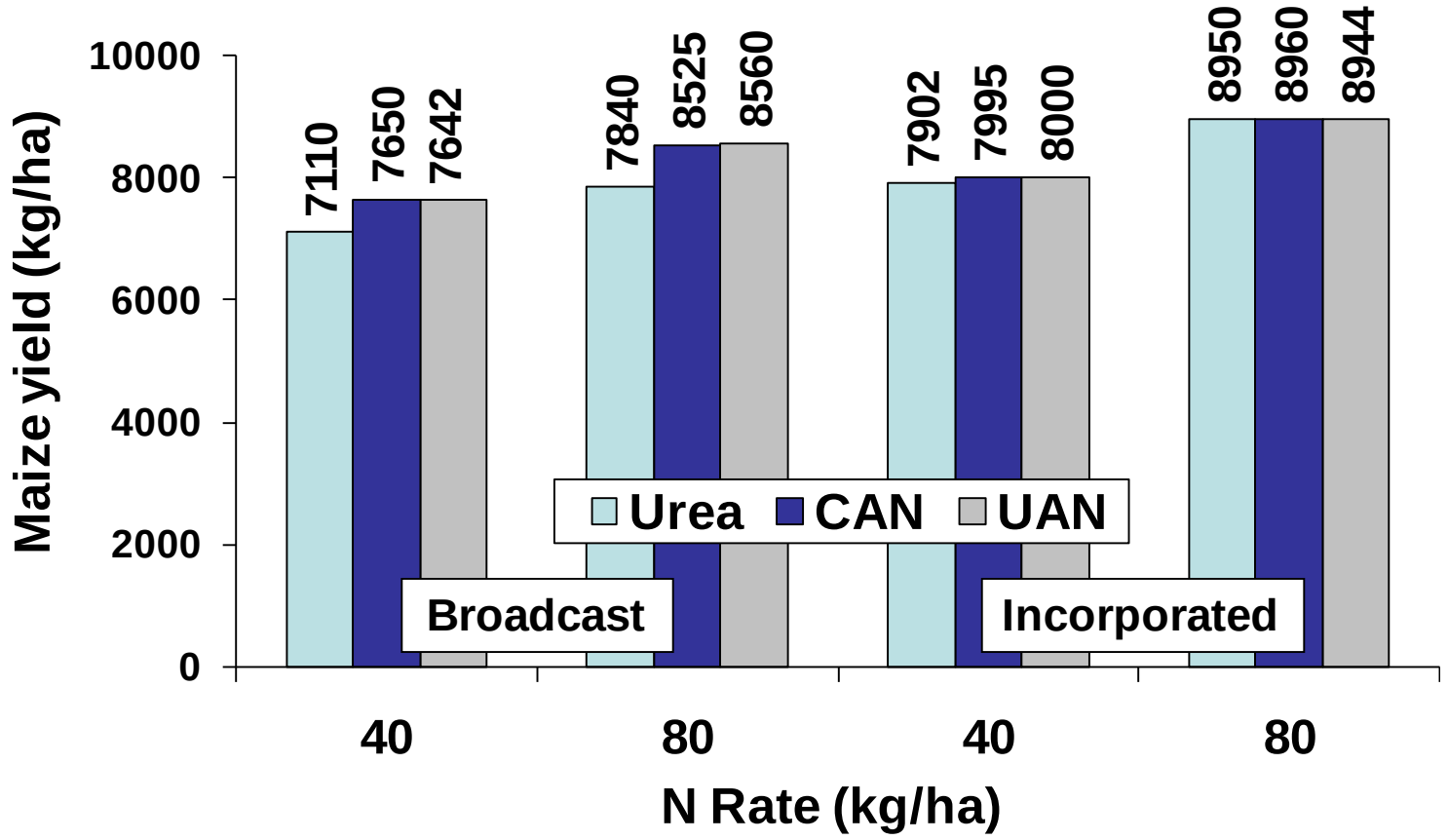
Right time: Grain yield under two different application times in wheat



** denotes significant differences between treatments*

Barbieri et al., 2008

Right source and place: Maize yield under different N sources and placement at central Santa Fe



Fontanetto, 2004

Current work looking at Enhanced-Efficiency Nitrogen Sources:
Urease and nitrification inhibitors

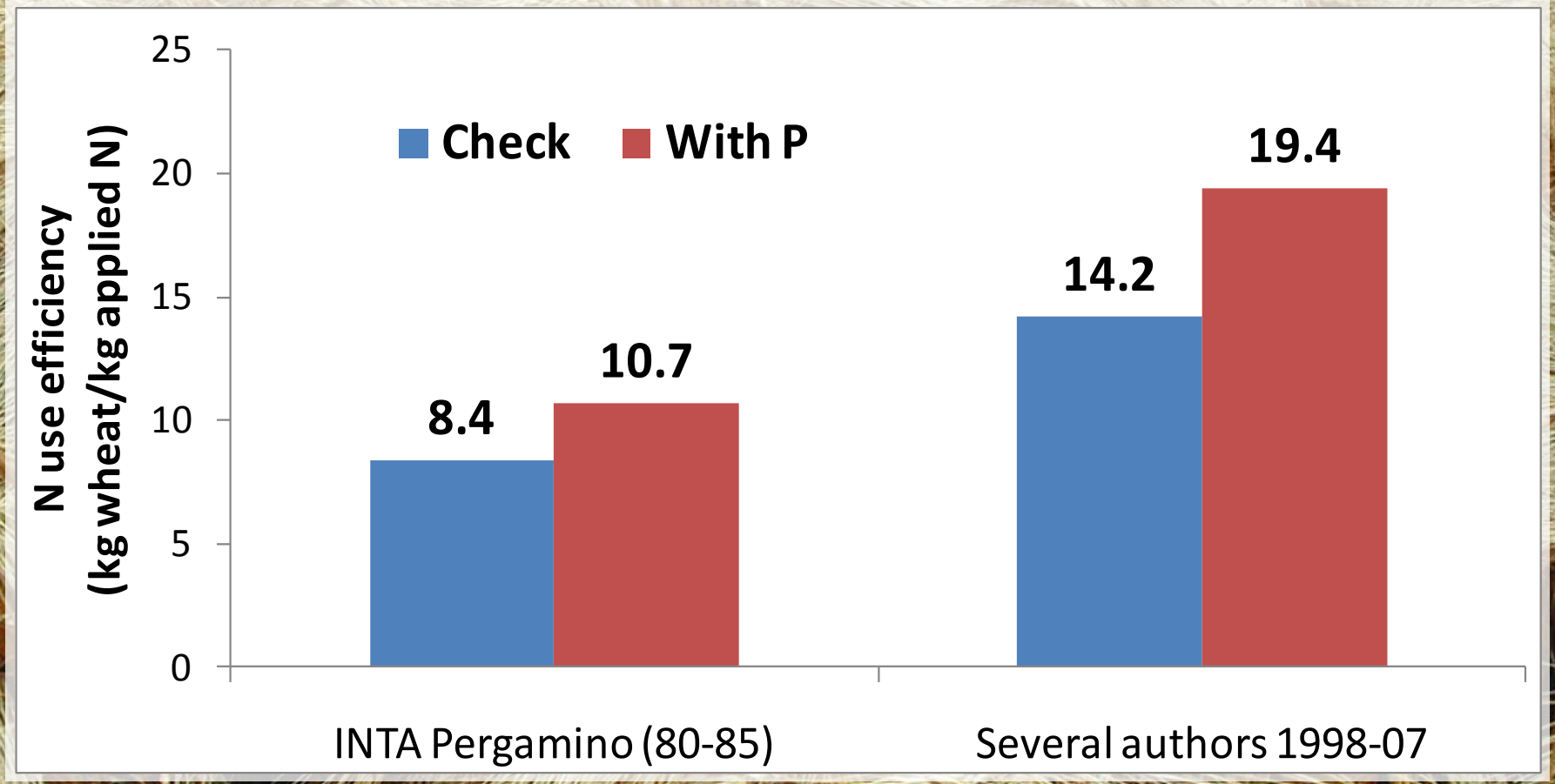
Urease Inhibitors in Maize

Fontanetto, Bianchini et al., 2007/08

Treatment	NH_3-N Losses	Grain yield	NUE
	%	kg/ha	kg grain/kg N
Check	-	7334	-
Urea 70N	10	8381	15
Urea 70N + NBTPT	4	9166	26
Urea 140N	25	9623	16
Urea 140N + NBTPT	6	10368	22

Wheat: N use efficiency without and with P application

Compiled from Senigagliesi et al. (1987) and other authors (1998-2007)



Nitrogen use efficiency (NUE), N Recovery efficiency (RE) and N Internal efficiency (IE) of wheat crops fertilized only with N (N100) and N + S (N100+ S20)

Variable	Units	N100	N100 +S20
NUE	kg grain per kg applied N	8.4	10.7
RE	kg N uptake per kg applied N	0.35	0.47
IE	kg grain per kg N uptake	22.7	22.5

Salvagiotti et al., 2009

Hairy vetch as winter crop supplying N for maize (J. Romagnoli. 2007/08)

5000 kg DM → 130 kg/ha N

Final considerations

- ✓ Right N management for increasing the overall production of grain crops and cropping system effectiveness and efficiency, and simultaneously avoiding negative effects on the environment
- ✓ Tools for deciding the right rate, source, time, and placement of fertilizer N have been developed
- ✓ Future research should be oriented at exploring causes that may increase NUE:
  - ✓ grain yield gaps and constraints for grain production in different cropping systems
  - ✓ Nutrient recommendations should be based in more mechanistic approaches
- ✓ It is also important to look for the impact of N management on the whole system effectiveness not only in the short- but also in the long-term by watching the direct effects of nutrient addition, and also the indirect effects through increasing organic matter in soils

Thank you!!

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