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Optical Sensing Regional Project for Corn. A Quebec - China Comparative Study

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Average N rates in China

Figure 1. Provincial differences in average nitrogen fertilizer application rates per crop in the P.R. China for the year 2000. Calculated from the statistics of sown area and total nitrogen consumption (4). The "sown area" comprises all major agricultural crops, including vegetables. Orchards and grassland not included. Compound fertilizer calculated on the basis of 30% N.

- Excessive mineral N fertilization has become common in most major grain producing regions of China since the late 1980s, and for cash crops in China since the 1990s.
- It causes large amounts of nitrate to accumulate in the soil profile and an increase in nitrate leaching to waterbodies.

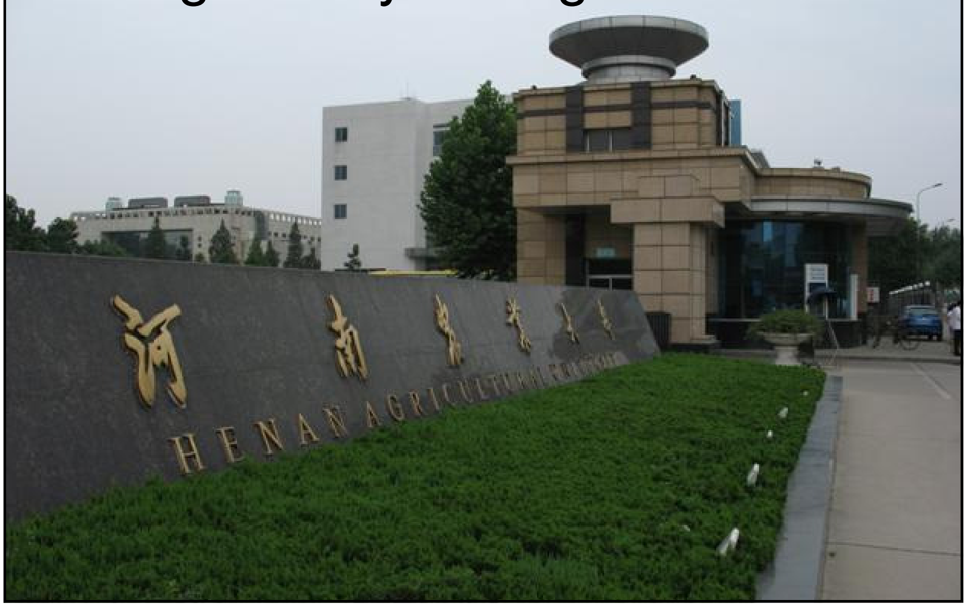
Ju X.T., Liu X.J., Zhang F.S., Roelcke M. (2004) Nitrogen fertilization, soil nitrate accumulation, and policy recommendations in several agricultural regions of China. Ambio 33:300-305.

Intensive wheat–maize double cropping system, North China Plain

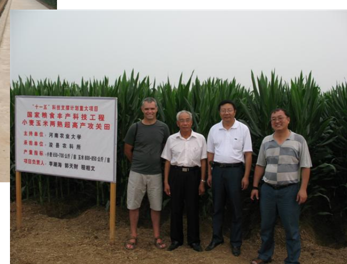
- Crop yield of both wheat and maize did not increase significantly at N rates above 200 kg N ha^{-1}.
- Higher NO_3-N leaching occurred in maize season than in wheat season due to more water leakage caused by the concentrated summer rainfall.
- Optimum N rate may be much lower than that used given the high level of N already in the soil

Fang Q.X., Yu Q., Wang E.L., Chen Y.H., Zhang G.L., Wang J., Li L.H. (2006) Soil nitrate accumulation, leaching and crop nitrogen use as influenced by fertilization and irrigation in an intensive wheat-maize double cropping system in the North China Plain. Plant and Soil 284:335-350.

Agronomy College of HAU



Research on corn in the Henan province, China



Wheat-Maize Double Cropping System

Canada-China « Mirror » Study 2008 (Chinese Site)

- Xun County, Henan province
- Sandy loam
- *Zea mays* L., cultivar Zhengdan 958
- Urea
- Sidedressed N applied near V8
- 75,000 plant ha^{-1}

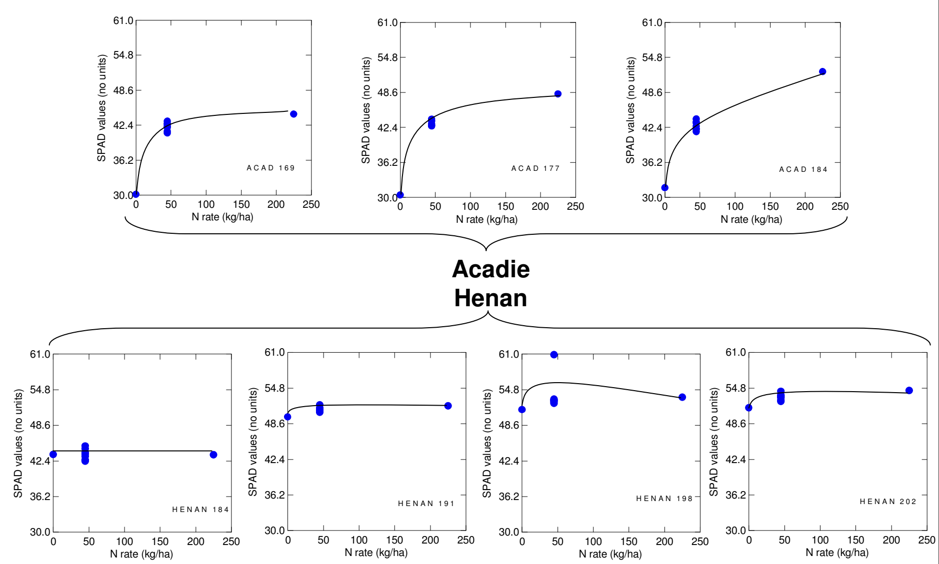
N fertilization treatments

		N at sowing kg N / ha	N at topdressing kg N / ha	Total N kg N / ha
1	Control	0	0	0
2	Reference plot	45 +180N	0	225
3	Response curve	45	0	45
4	Response curve	45	34	79
5	Response curve	45	68	113
6	Response curve	45	102	147
7	Response curve	45	136	181
8	Response curve	45	170	215
9	Response curve	45	204	249
10	*Chinese practice*	*45*	*330*	*375*

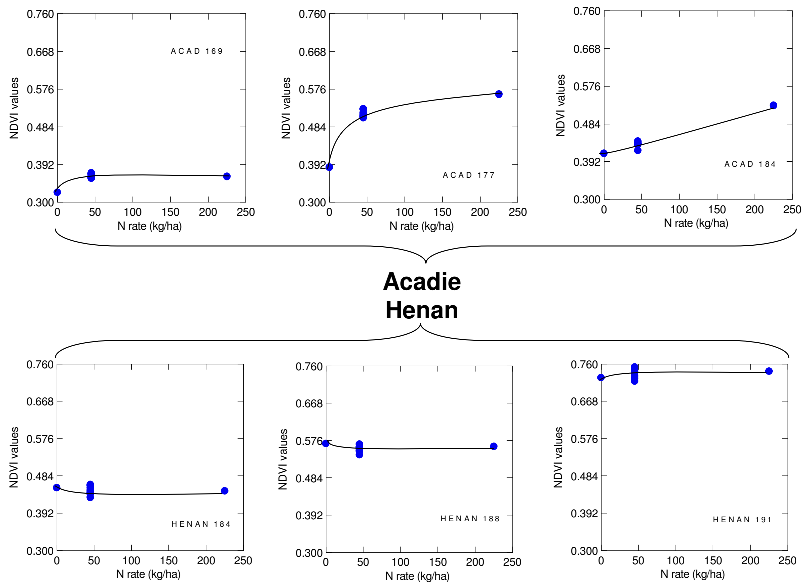
Soils characteristics pre-sowing

	pH_w	pH_{CaCl_2}	E.C. µmho/cm	% O.M.	% C
Acadie	7.28	6.62	67	3.74	2.18
Henan	7.96	7.37	337	2.56	1.49

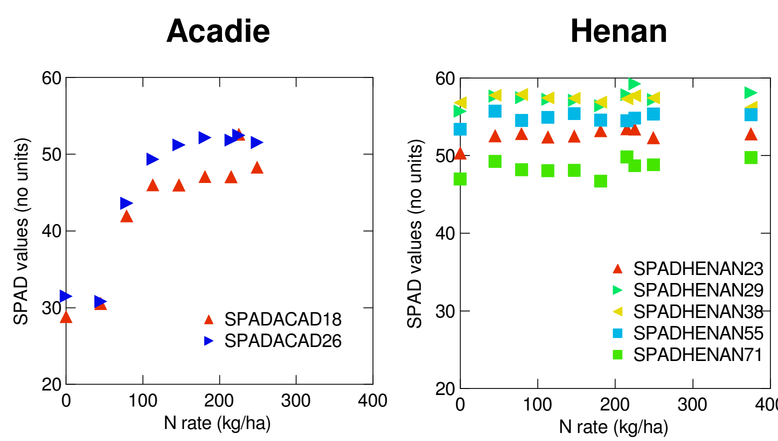
SPAD at different dates before topdressing



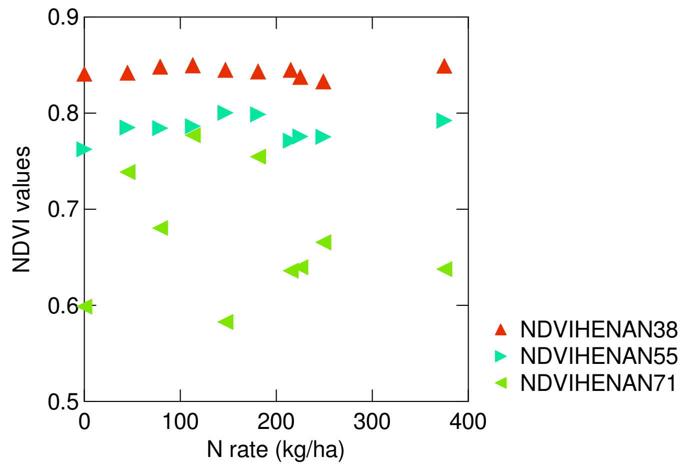
NDVI at different dates before topdressing



SPAD at dates after topdressing



NDVI at dates after topdressing (Henan only)

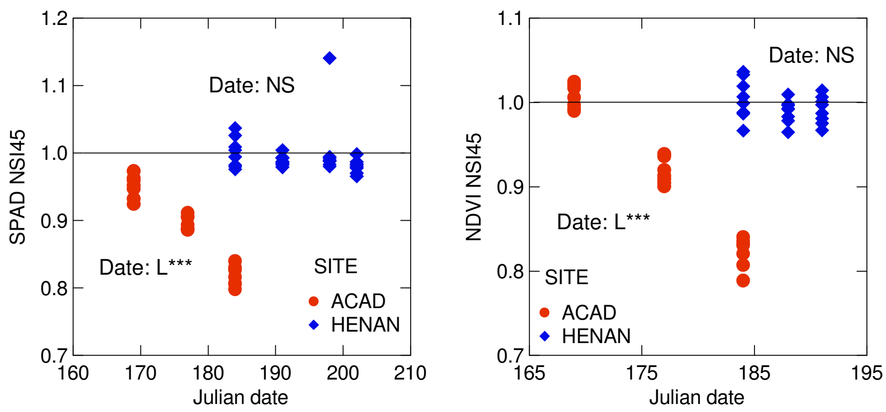


Sufficiency Index

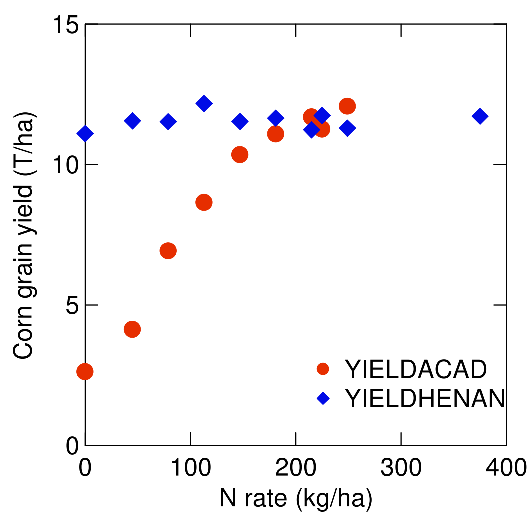
		N at sowing kg N / ha	N at topdressing kg N / ha	Total N kg N / ha
1	Control	0	0	0
2	**Reference plot**	**45 +180N**	**0**	**225**
3-9	Response curve	45	0-225	45-375
10	*Chinese practice*	*45*	*330*	*375*

$$\frac{\text{“SPAD or NDVI”} * 100}{\text{Reference plot}}$$

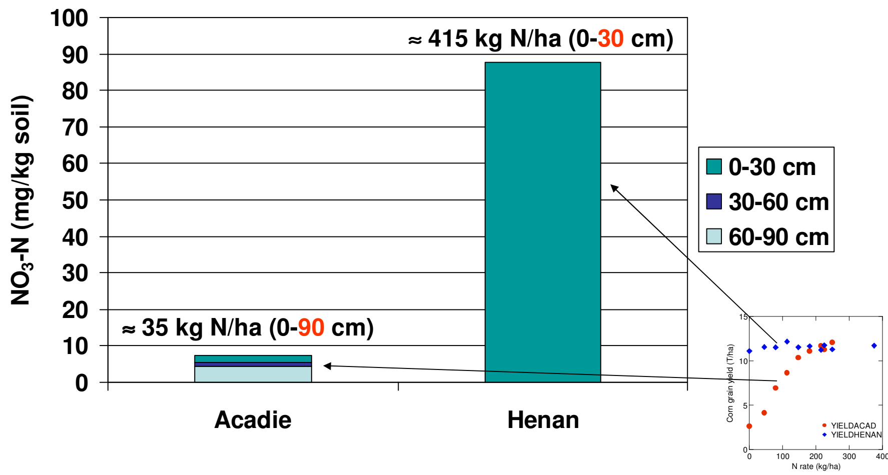
NSI evolution of corn fertilized with 45 kg N/ha at sowing



Yield Responses to N Rate

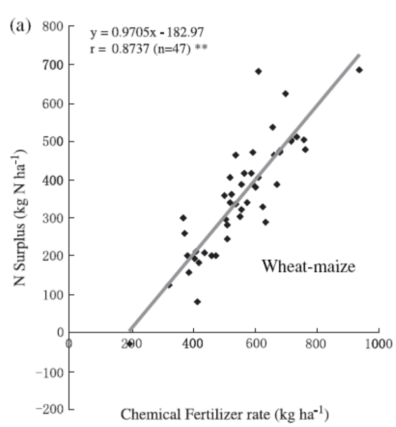


Average NO_3-N in the soil profile before sowing



Residual soil nitrate-N after harvest in wheat-maize, Shandong province, North China

≈250 kg N ha^{-1} (0-90 cm) + ≈ 230 kg N ha^{-1} (90-180 cm)



Ju X.T., Kou C.L., Zhang F.S., Christie P. (2006) Nitrogen balance and groundwater nitrate contamination: Comparison among three intensive cropping systems on the North China Plain. Environmental Pollution 143:117-125.

Intensive wheat–maize double cropping system, North China Plain

- Avoiding excess water leakage through controlled irrigation and matching N application to crop N demand is the key to reduce NO_3-N leaching and maintain crop yield.
- Such management requires knowledge of crop water and N demand and soil N dynamics as they change with variable climate temporally and spatially.

Fang Q.X., Yu Q., Wang E.L., Chen Y.H., Zhang G.L., Wang J., Li L.H. (2006) Soil nitrate accumulation, leaching and crop nitrogen use as influenced by fertilization and irrigation in an intensive wheat-maize double cropping system in the North China Plain. Plant and Soil 284:335-350.

The main ways to address N pollution

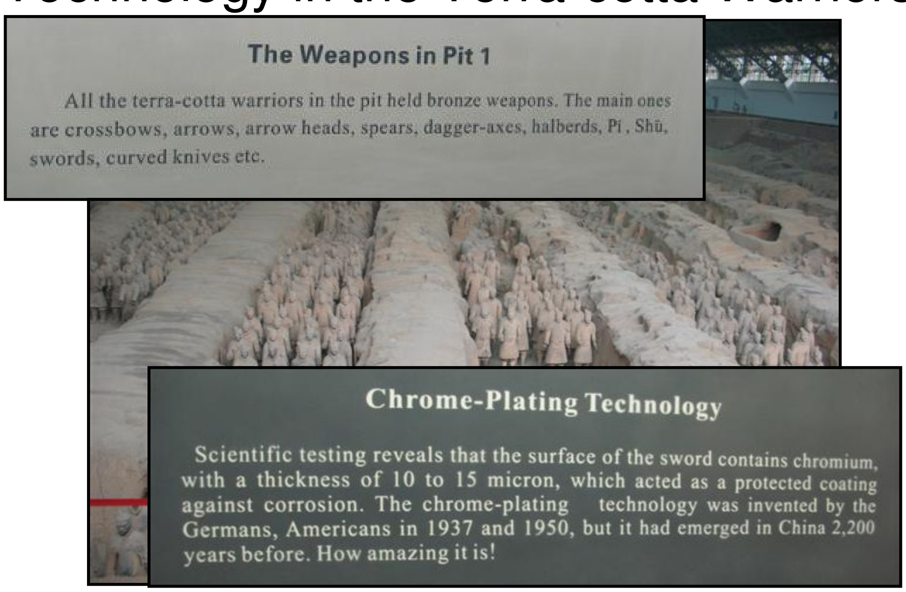
- **Scientific research and technological development, such as improved agricultural production techniques to help realize reasonable N fertilizer inputs by increasing the recovery rate by crops and reducing N fertilizer losses.**
- Public information and education methods, such as training courses for farmers, support for advisory services, etc.
- "Command-and-control" policy measures and legislation: Compulsory rules controlling N fertilizer application rates on an area basis and residual inorganic N in soil after harvest, or upper limits on number of animals per ha, etc.
- Economic instruments, such as taxes on N fertilizers, subsidies to farmers for environmentally-sound farming practices, or indirect effects through prices of agricultural produce.

Ju X.T., Liu X.J., Zhang F.S., Roelcke M. (2004) Nitrogen fertilization, soil nitrate accumulation, and policy recommendations in several agricultural regions of China. Ambio 33:300-305.

Conclusions

- What is best? Soil-based or plant-based?
  - N loaded soils: soil-based
- Plant-based need more sensitivity
  - Provide low starter N
  - Find sensing technologies more sensitive

Technology in the Terra-cotta Warriors



Thank you

For more information:

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