

Fates of the applied nitrogen fertilizer after harvesting wheat on dryland soil

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Outlines

1. Background
2. Approach
3. Results
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1. Background

China has consumed near 1/3 of synthetic fertilizers in the world.

Recovery rate of N fertilizer after a growing season in China is about 1/3 of N fertilizer added (30%-35%).

- N fates:**
- uptake
 - residual in soil
 - loss

Table 1 Results of N fates from different researches

N fates	Huack (1984)	Glendining et al.(1997)	Sebilo et al (2013)	Ju et al (2009)	Angus (2016)
Uptake	50%	51%	45-50%	18-31%	44%
Residual in soil	25%	30%	32-37%	22-46%	34%
Loss	25%	19%		22-49%	22%
References	Nitrogen in Crop Production, ASA-CSSA-SSSA	Plant and Soil, 1997	PNAS	PNAS	INI conference

Averagely, 1/3 of N added retained in soil after a growing season.

The soil in the Loess Plateau with very deep profile.



Our concerns:

The fate of residual N in this soil?

2. Approach

Adding ^{15}N -urea in the different fertilization treatments of a long-term fertilization experiment (Since 1990-, Yangling, China)

Code	Different fertilized soils
No-F	No fertilizer (No-F)
NPK	Inorganic N, P, and K fertilizers
MNPK	Cattle manure + NPK fertilizers (70% of N from manure, and 30% from inorganic N fertilizer)

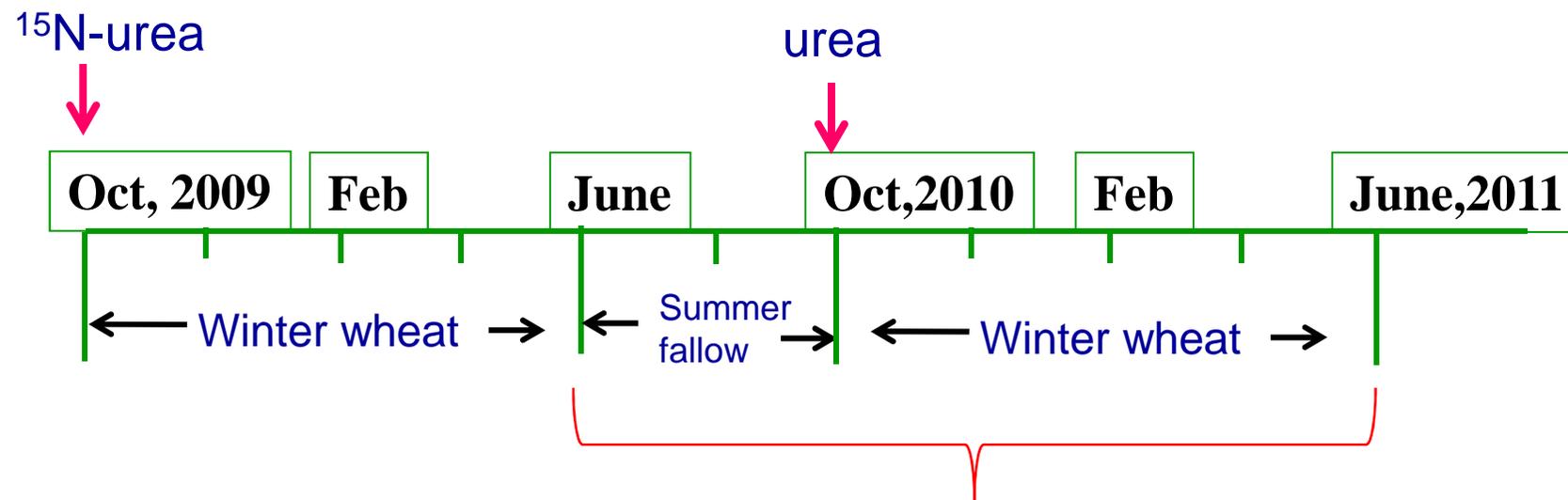


Table 1 The properties of three different fertilized soil for 19-years (0-15 cm)

Soils	Organic C (g kg ⁻¹)	Total N (g kg ⁻¹)	Mineral N (mg kg ⁻¹)	Olsen- P (mg kg ⁻¹)	Available K (mg kg ⁻¹)
Control	7.50	0.90	7.6	3.2	177
NPK	9.20	1.10	11.1	44.4	279
MNPK	13.20	1.40	27.2	110.7	345

Winter wheat-fallow

■ ^{15}N fertilization and crop rotation



^{15}N isotope method:

Micro-plot (soil column) experiment added with ^{15}N fertilizer



October, 2009

3. Results

Forms and contents of residual N after harvesting the wheat in June, 2010

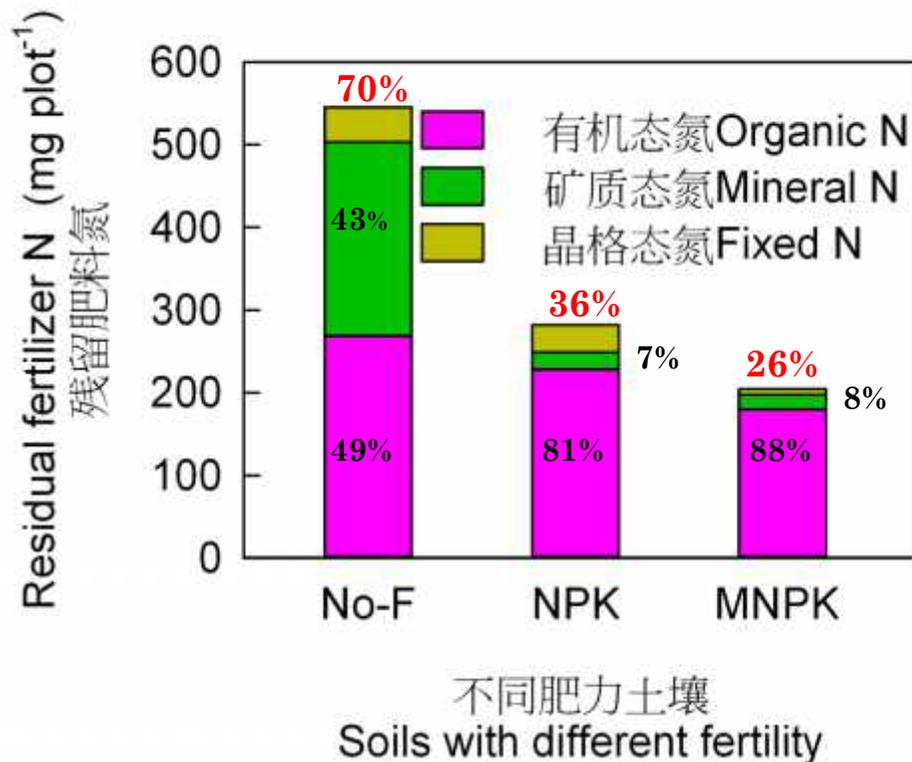
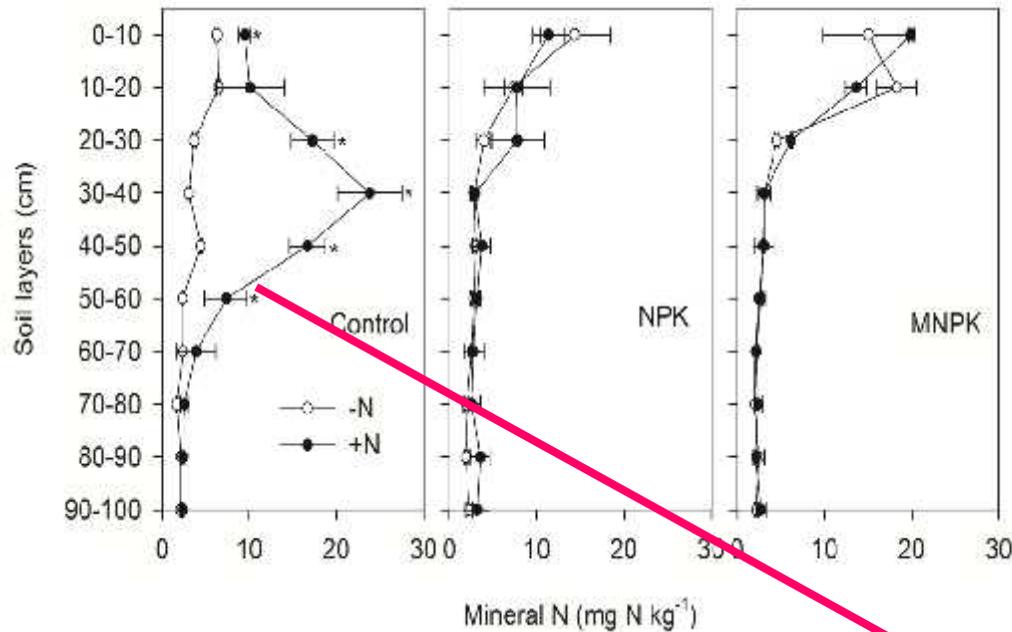


Figure 1 Forms and contents of residual fertilizer N after harvesting the wheat

Mineral N in soil profiles after harvesting wheat



Liang B, et al. *Biology and Fertility of Soil*, 2013, 49:977–986

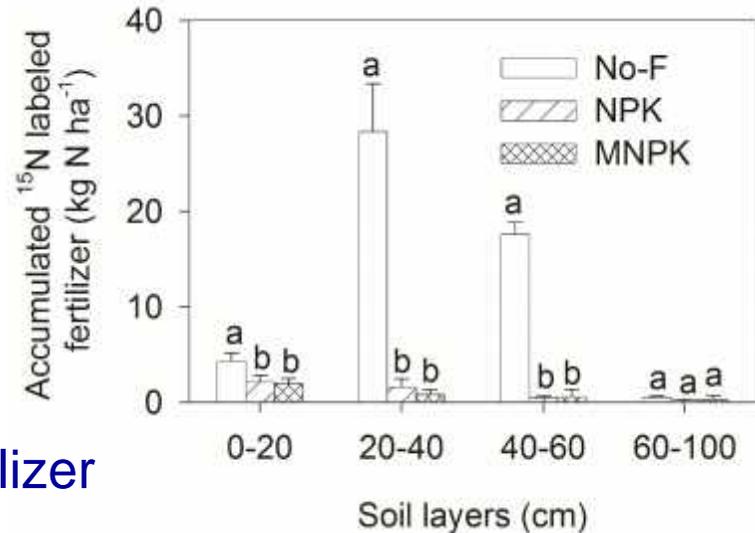


Fig2 Mineral N derived from the ¹⁵N fertilizer in 0-100 cm profiles of different soils

Summer fallow (late June to September) is a common practice on dryland farming to conserve water and regenerate soil fertility.



- **Rain season: 2/3 of annual rainfall during the three months**
- **High residual fertilizer N in soil**

High potential of N loss?

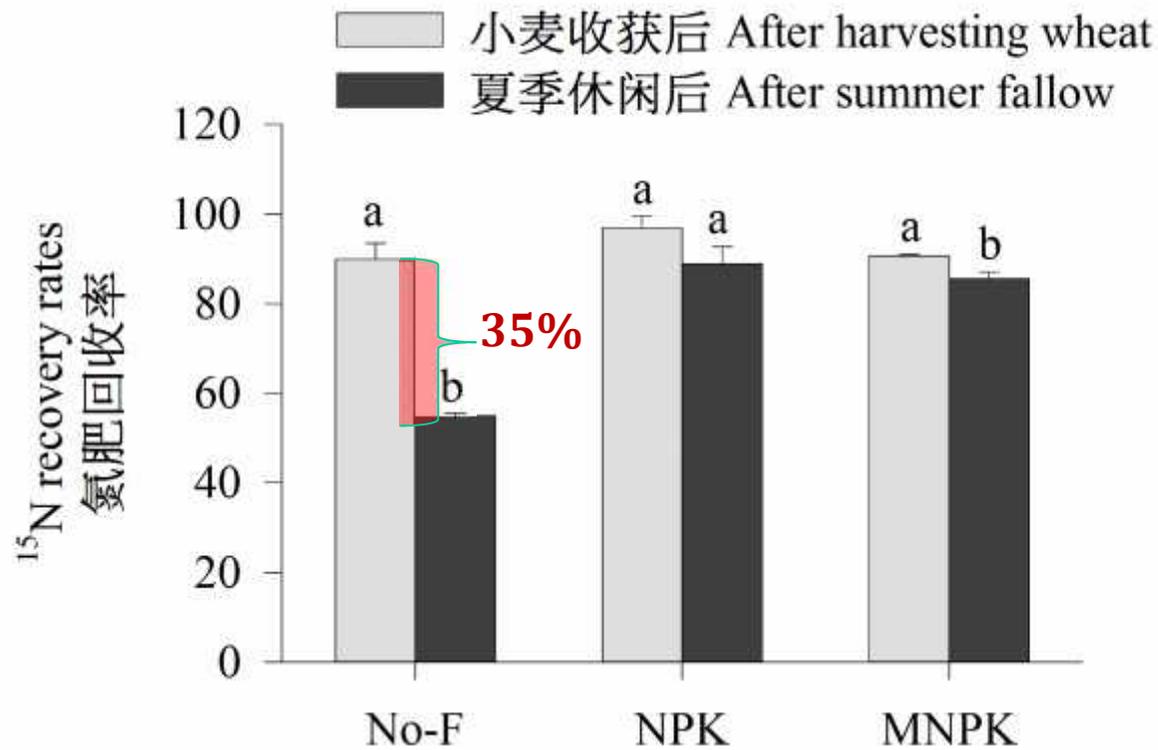


Fig.3 The recovery of ^{15}N in soil profile (0-100 cm) after wheat harvesting and summer fallow

High rate of residual ^{15}N fertilizer in No-F soil after harvesting wheat was lost during the summer fallow.

Residual N used by the second wheat

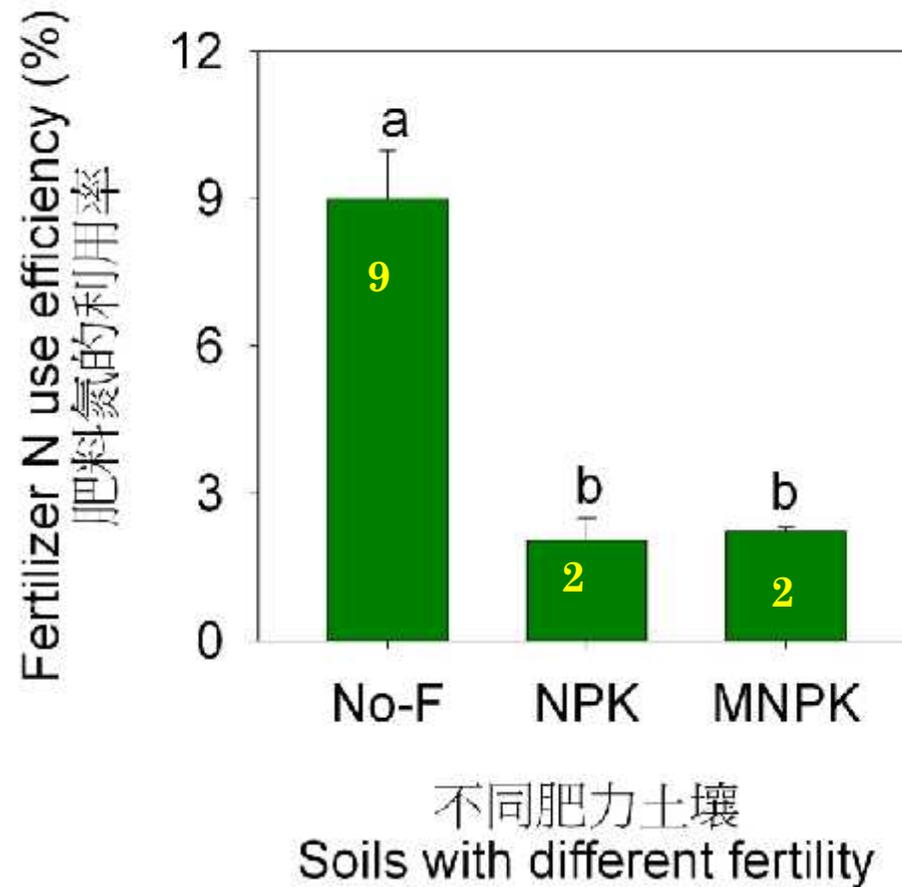


Figure4 Recovery rate of residual N used by the second wheat (percentage of ^{15}N added)

Residual N at the different times

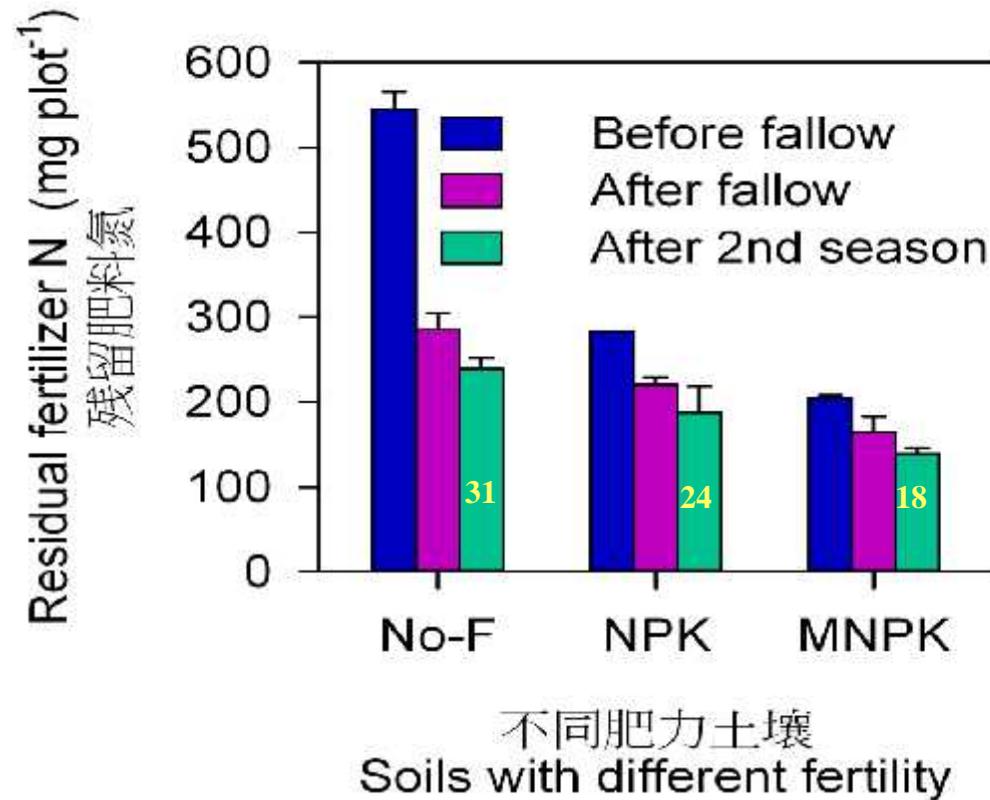


Figure 5 Residual N at the different times (summer fallow and after harvesting the second wheat)

About 20-30% of the added N was still remained in soil after harvesting the second wheat.

Residual N in soil profiles at the different times

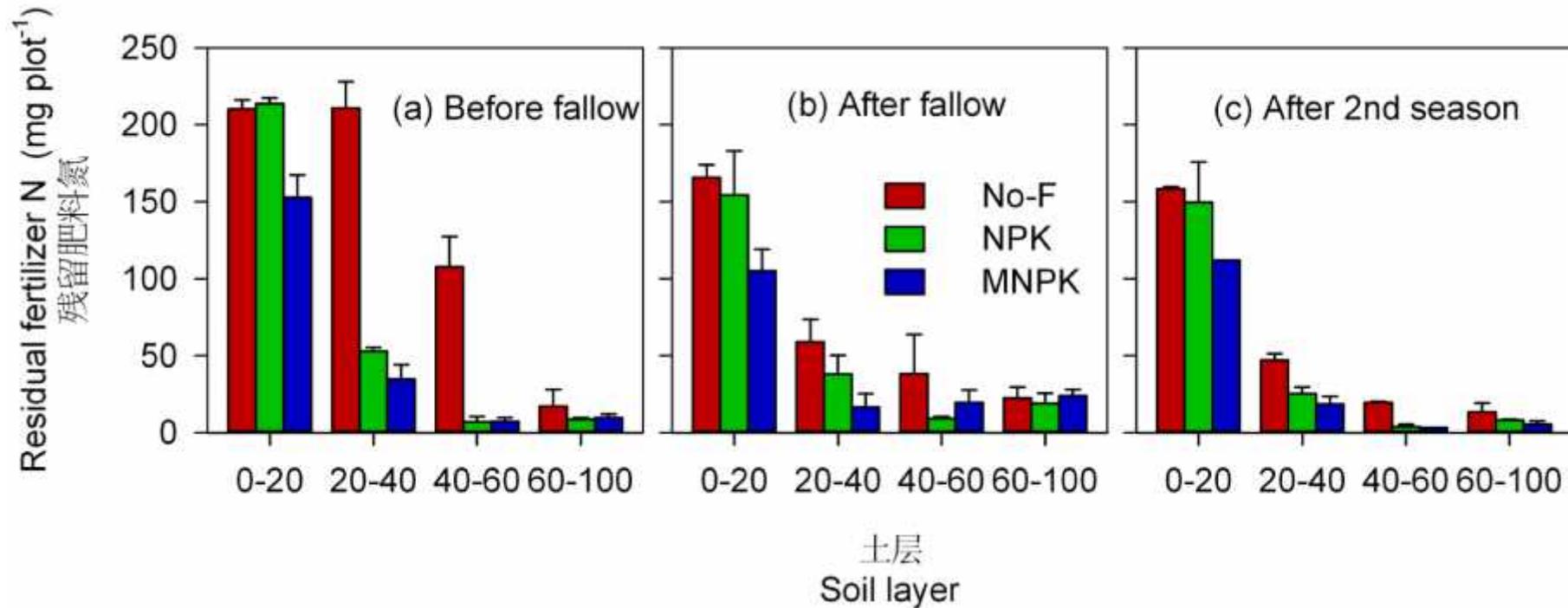


Figure 6 Residual N in soil profiles (0-100 cm) at the different times

4. Conclusions

◆ The residual N in soil after harvesting crop is not totally lost from soil. It could be used by the next crop in dryland.



The plot sizes of a 10 yrs N rate experiment (2003-2013) after 3 years of stopping addition of N fertilizer (March, 2016)

- How to prevent loss on residual N during summer fallow is an important issue.
- The re-use of residual N in soil with deep profile (such as the loess Plateau)?

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Thanks + questions?