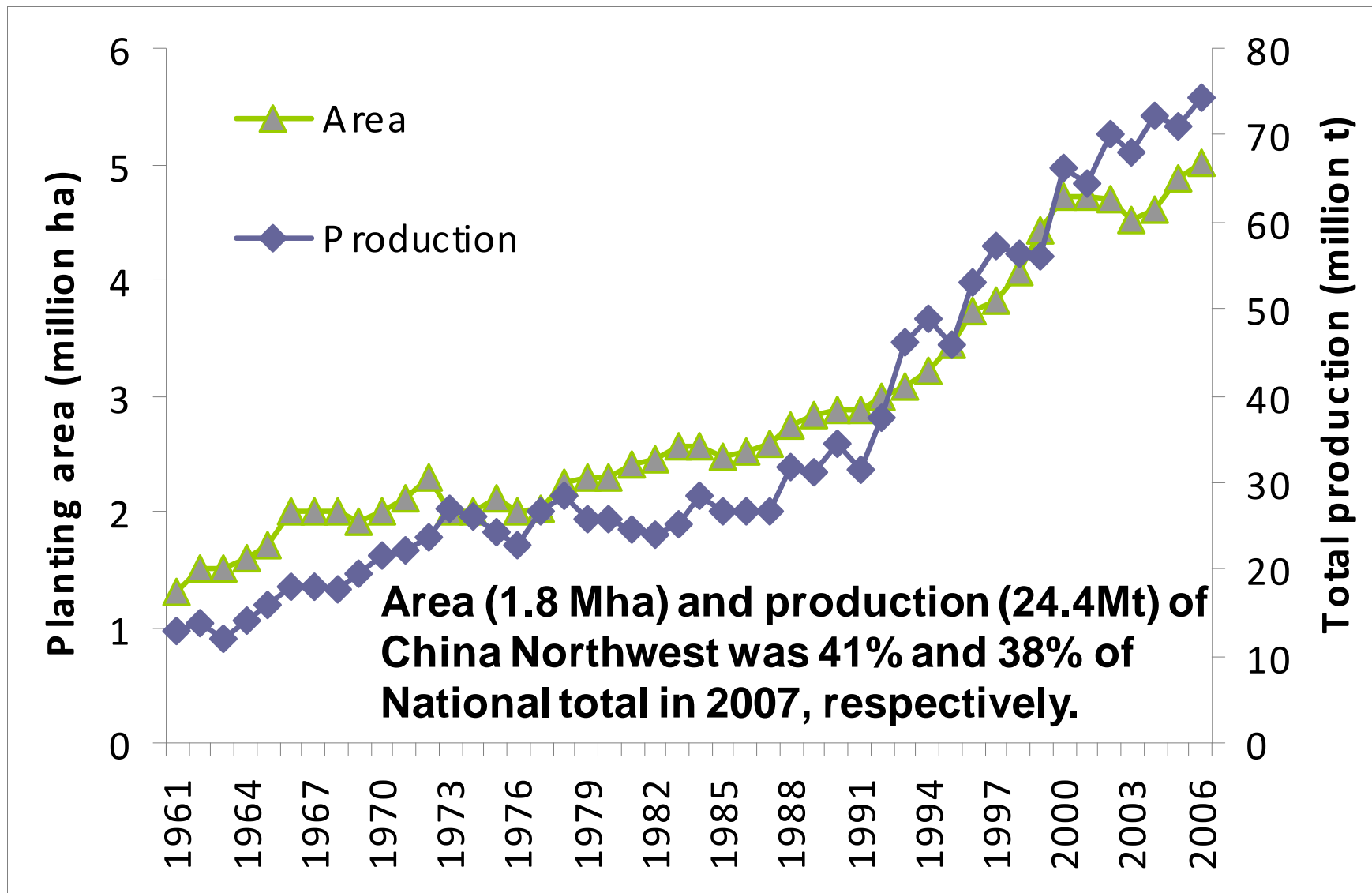




# **Agronomic Evaluation of Nutrient Management for Potato in Northwest China**

**Shutian Li, Jiyun Jin, Yu Duan, Zhanquan Chen,  
Tianwen Guo, Youhong Li, Yan'an Tong**

# Changes of Potato area and production



## Characteristics and issues in Northwest China

- Sufficient sunlight and high yield potential
- Great difference between day and night temperature
- Imbalanced fertilization
- Water shortage



# Objectives

- **To demonstrate soil indigenous fertility of nutrient N, P and K**
- **To determine the limiting nutrient and nutrient use efficiency**
- **To evaluate the nutrient management practice compared with farmer's practice**

## Summarized soil information of the experimental sites

Soil parameters	N trials (n=28)		P trials (n=34)		K trials (n=66)	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
Soil texture	Sandy loam, loam					
pH in water (1:2.5)	8.3	3	8.2	3	8.2	3
SOM (g kg <sup>-1</sup> )	10.0	44	9.0	59	9.0	62
Mineral N (mg L <sup>-1</sup> )	28.3	81	24.2	90	21.0	96
Available P (mg L <sup>-1</sup> )	16.3	47	17.7	43	17.0	40
Available K (mg L <sup>-1</sup> )	94.2	37	97.2	32	94.5	35

# Experiment treatments

- **Nutrient management practice (OPT)**
  - Nutrient recommended using Agro Services International (ASI) systematic approach
- **Nutrient omitting plots**
  - OPT- N
  - OPT-P
  - OPT-K
- **Farmer practice (FP)**

## Nutrient recommendation based on ASI procedure

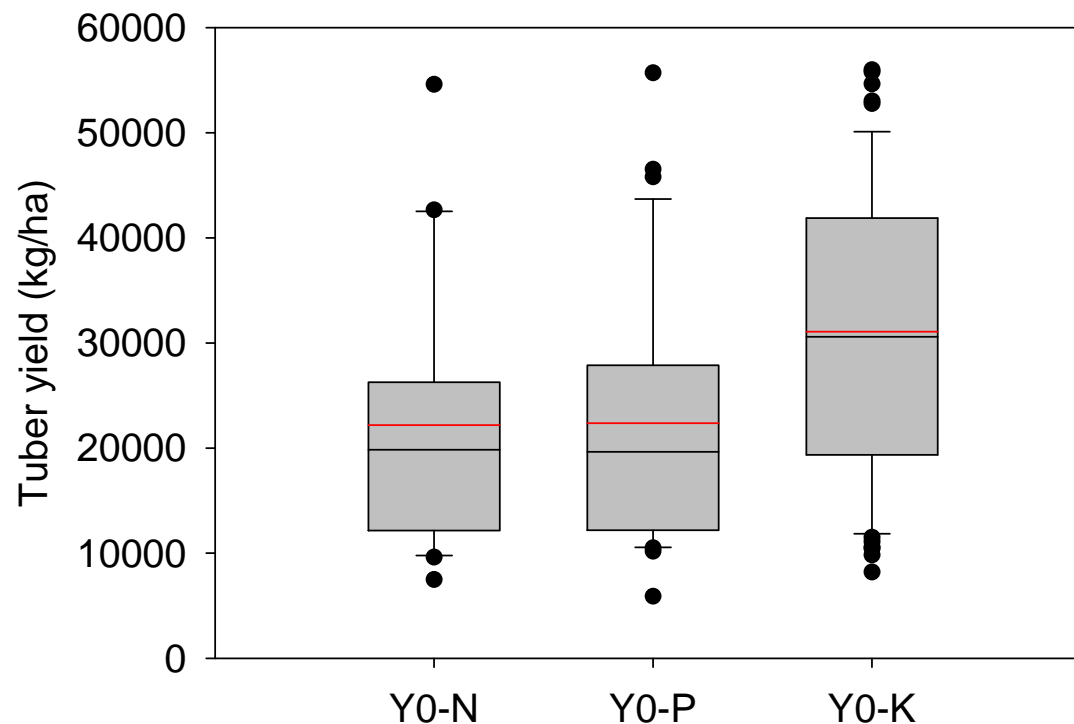
<b>Measurement</b>	<b>Mean</b>	<b>SD</b>	<b>Min.</b>	<b>Max.</b>	<b>CV (%)</b>
<b>N (n=28)</b>	<b>135</b>	<b>58</b>	<b>45</b>	<b>307</b>	<b>43</b>
<b>P<sub>2</sub>O<sub>5</sub> (n=34)</b>	<b>124</b>	<b>83</b>	<b>30</b>	<b>322</b>	<b>67</b>
<b>K<sub>2</sub>O (n=66)</b>	<b>139</b>	<b>68</b>	<b>30</b>	<b>300</b>	<b>49</b>

## Evaluated indicators

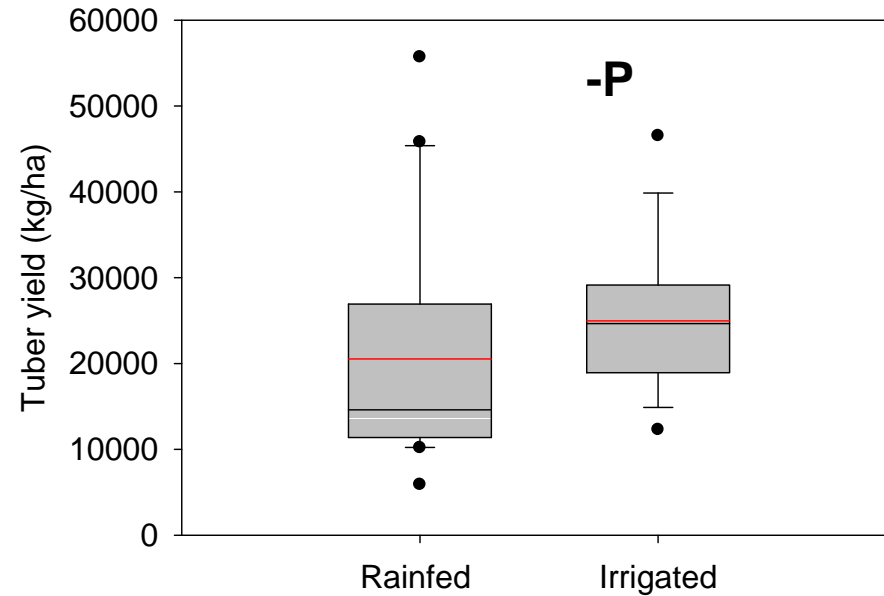
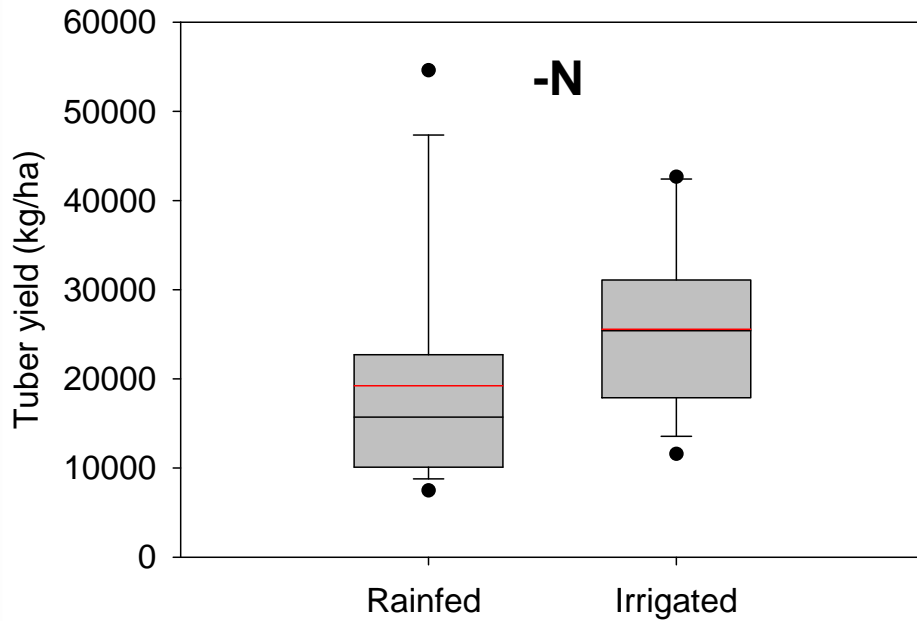
- **Indigenous nutrient fertility:**  $Y_0$
- **Yield response (%):**  $(Y - Y_0) / Y_0 \times 100$
- **Nutrient use efficiency**
  - Partial factor productivity (PFP) :  $Y / F$
  - Agronomic efficiency (AE) :  $(Y - Y_0) / F$
- **Nutrient management evaluation**
  - Yield
  - Nutrient use efficiency
  - Economic return

# Indigenous soil nutrient fertility

Measurement	Mean	SD	Min.	Max.	CV (%)
Yield in 0-N plot (kg/ha)	22170	11787	7500	54600	53
Yield in 0-P plot (kg/ha)	22360	11859	5900	55700	53
Yield in 0-K plot (kg/ha)	31500	13653	8200	56000	43

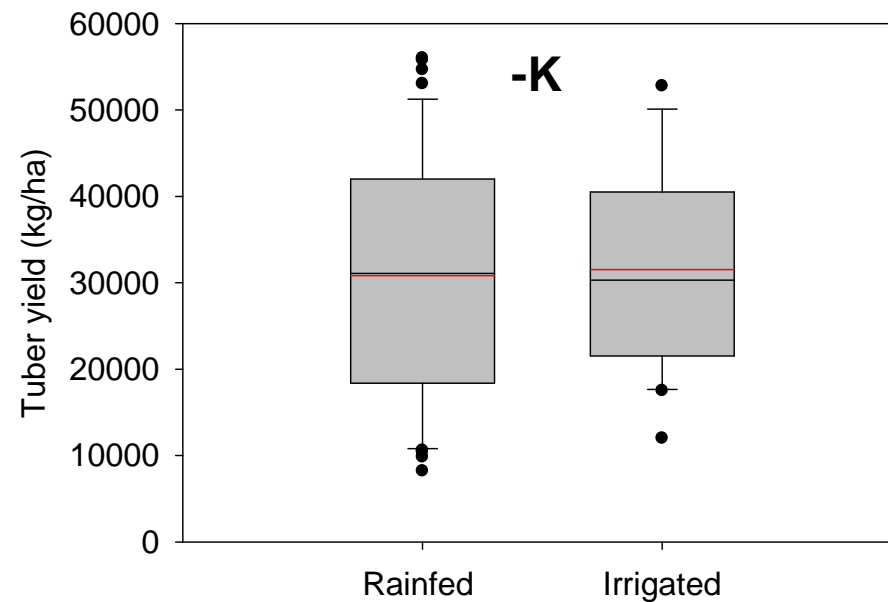


# Indigenous soil fertility in different water regime

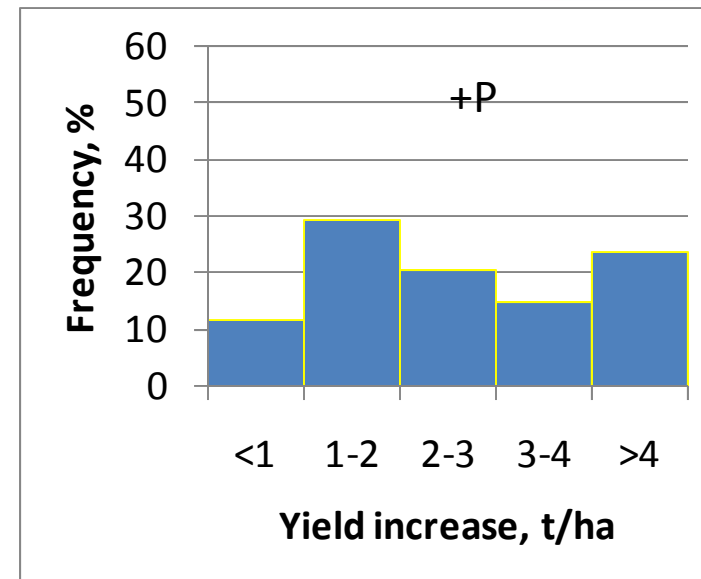
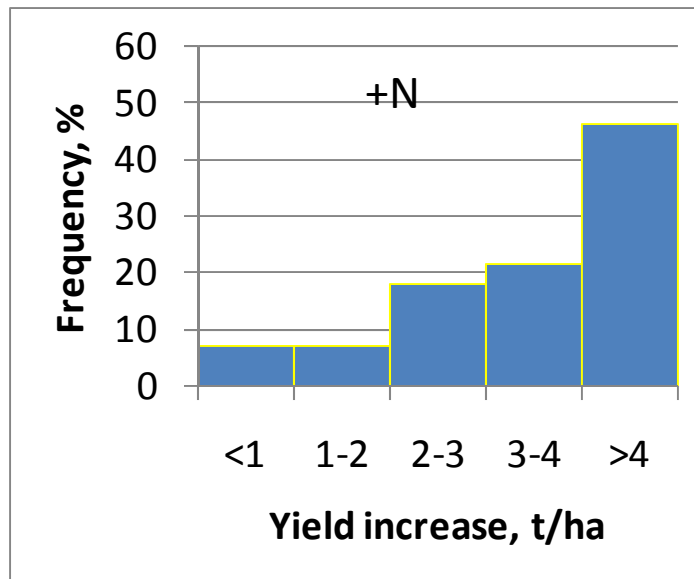


Mean yield (kg/ha)

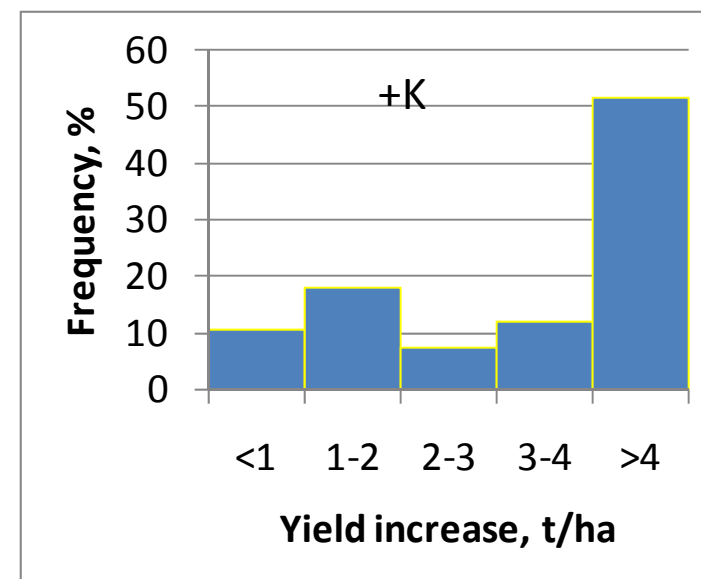
Y0	Rainfed	Irrigated
-N	19225 b	25568 a
-P	20507 b	24977 a
-K	30816 a	31527 a

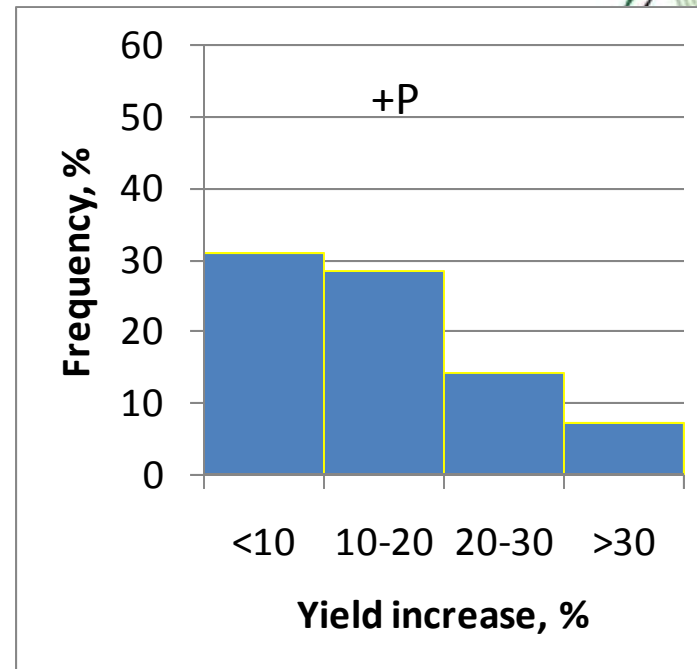
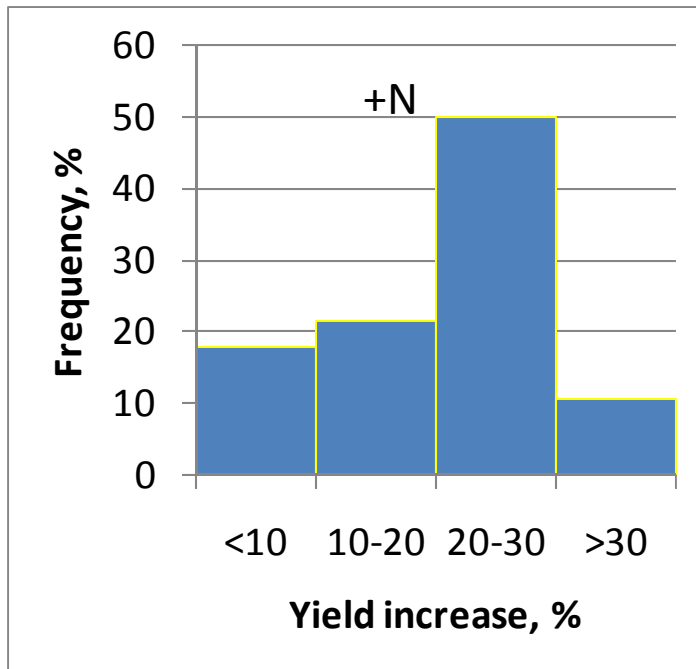


# Yield response to nutrient application

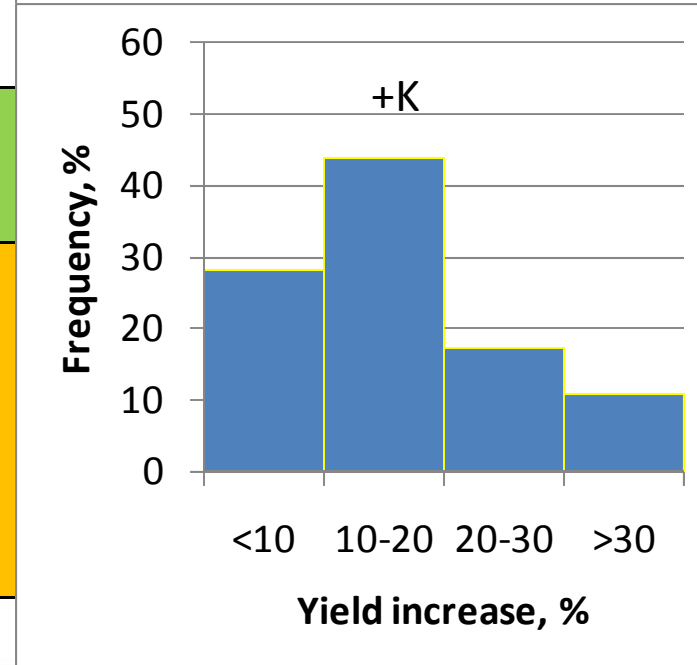


	Range (t/ha)	Mean (t/ha)	CV (%)
+N	0.5-8.9	4.2	51
+P	-0.2-6.1	2.9	66
+K	0.8-20.9	5.1	83





	Range (%)	Mean (%)	CV (%)
+N	3.1-44.0	20.8	47
+P	-1.0-62.7	14.9	81
+K	2.3-57.1	16.4	68

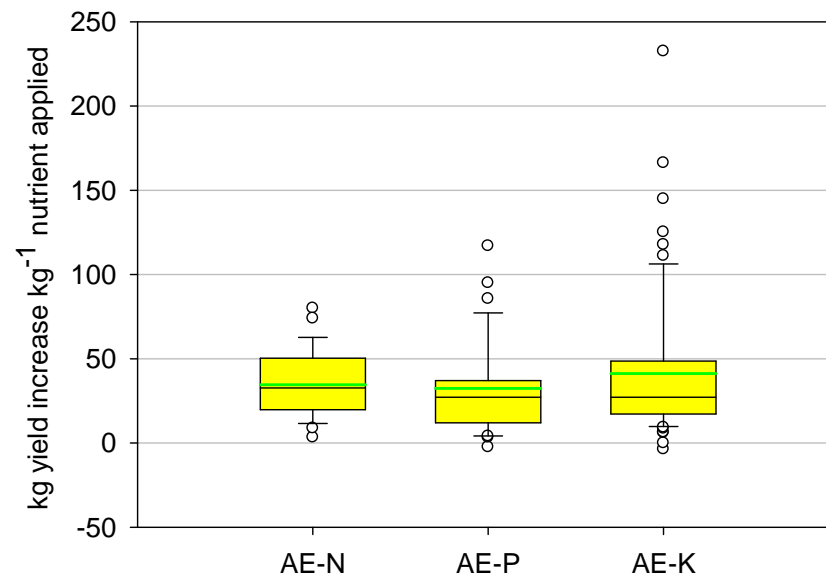
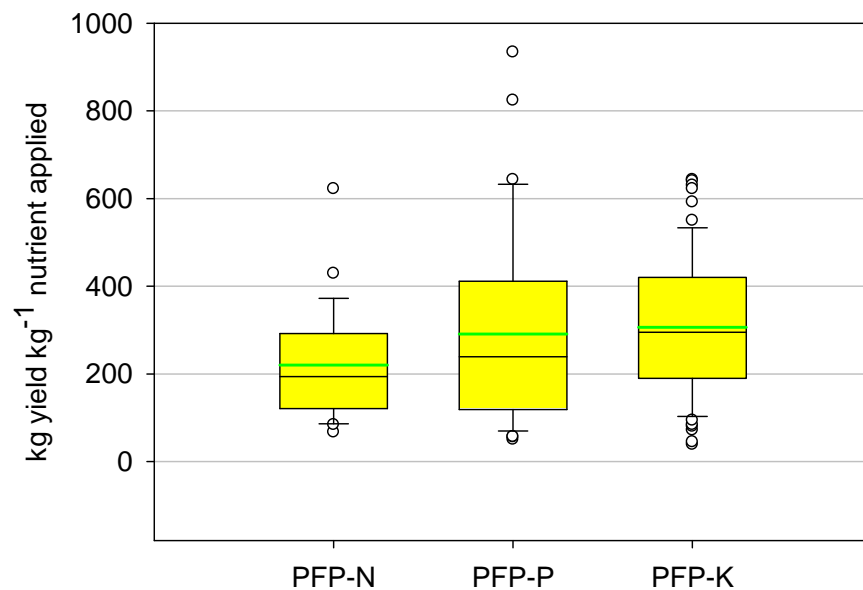


## Potato yield response under rainfed and irrigated conditions

Nutrient	Water regime	No. of trials	Nutrient Applied kg/ha	Yield increase t/ha	Yield increase %
<b>N</b>	<b>Rainfed</b>	<b>15</b>	<b>124.0 ± 68.9</b>	<b>3.6±2.1</b>	<b>22.2 ± 11.5</b>
	<b>Irrigated</b>	<b>13</b>	<b>147.2 ± 42.6</b>	<b>4.8±2.1</b>	<b>19.2 ± 7.6</b>
<b>P<sub>2</sub>O<sub>5</sub></b>	<b>Rainfed</b>	<b>20</b>	<b>108.7 ± 80.4</b>	<b>2.6±1.5</b>	<b>16.0 ± 14.0</b>
	<b>Irrigated</b>	<b>14</b>	<b>144.5 ± 85.1</b>	<b>3.2±2.2</b>	<b>13.4 ± 9.0</b>
<b>K<sub>2</sub>O</b>	<b>Rainfed</b>	<b>43</b>	<b>124.4 ± 61.1</b>	<b>5.6±4.9</b>	<b>17.6 ± 13.0</b>
	<b>Irrigated</b>	<b>23</b>	<b>165.5 ± 70.3</b>	<b>4.1±2.2</b>	<b>12.6 ± 6.4</b>

# Nutrient use efficiency

Nutrient	PFP kg kg <sup>-1</sup>		AE kg kg <sup>-1</sup>	
	Range	Mean	Range	Mean
<b>N (n=28)</b>	<b>67-622</b>	<b>220</b>	<b>3-80</b>	<b>35</b>
<b>P<sub>2</sub>O<sub>5</sub> (n=34)</b>	<b>50-934</b>	<b>291</b>	<b>-2-117</b>	<b>32</b>
<b>K<sub>2</sub>O (n=66)</b>	<b>39-643</b>	<b>306</b>	<b>6.2-233</b>	<b>43</b>



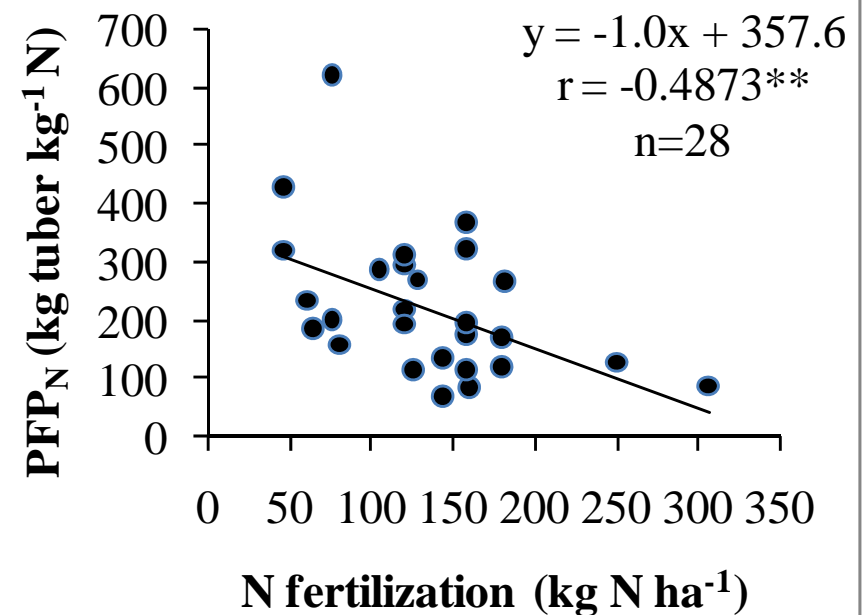
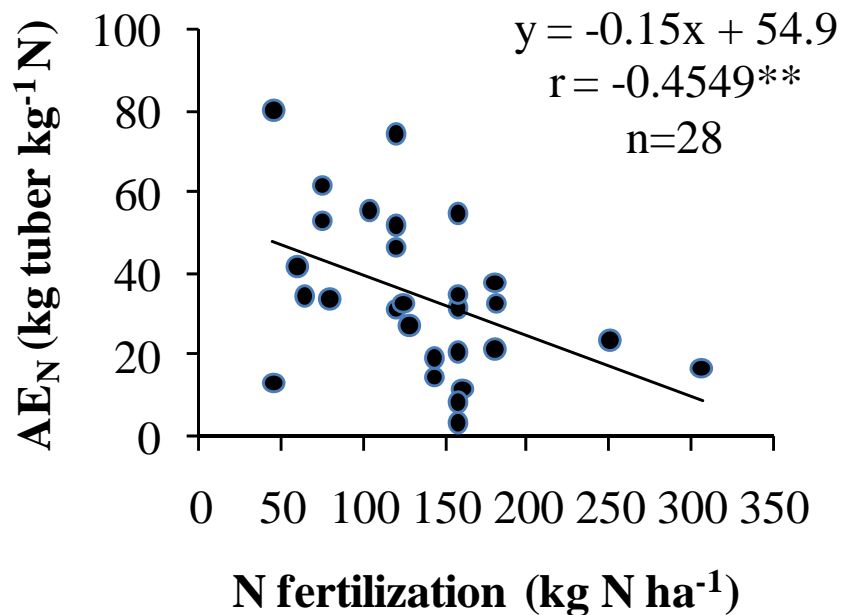
## Comparing N use efficiency with other results

<b>N rate (kg/ha)</b>	<b>AE-N (kg tuber /kg N)</b>	<b>PFP-N (kg tuber/kg N)</b>	<b>References</b>
45-307 (mean=135)	3-80 (mean=35)	67-622 (mean=220)	Current study China
134	46	348	Curless et al., 2004 USA
90	143	334	Kumar et al., 2007 India
180	99	195	
270	81	145	
360	63	111	
100	117	353	Zebarth et al., 2006, Canada

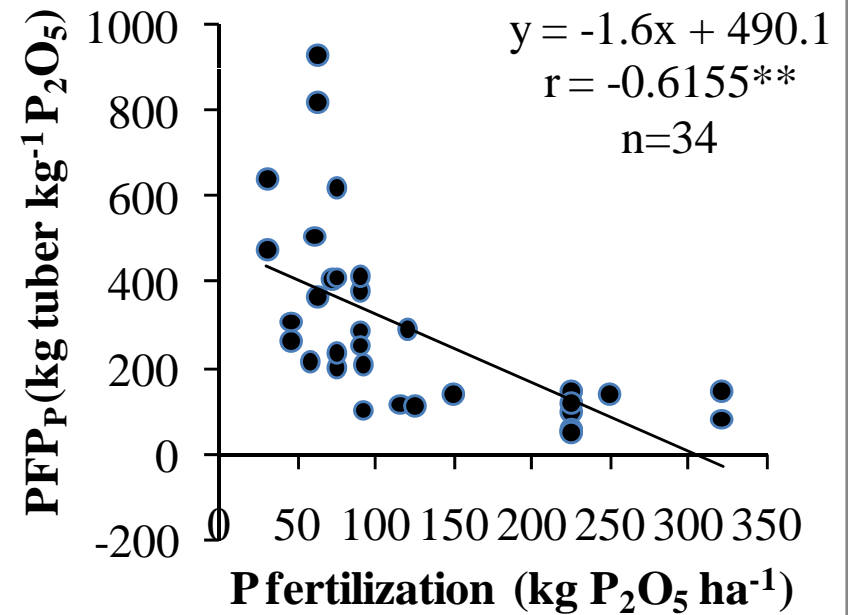
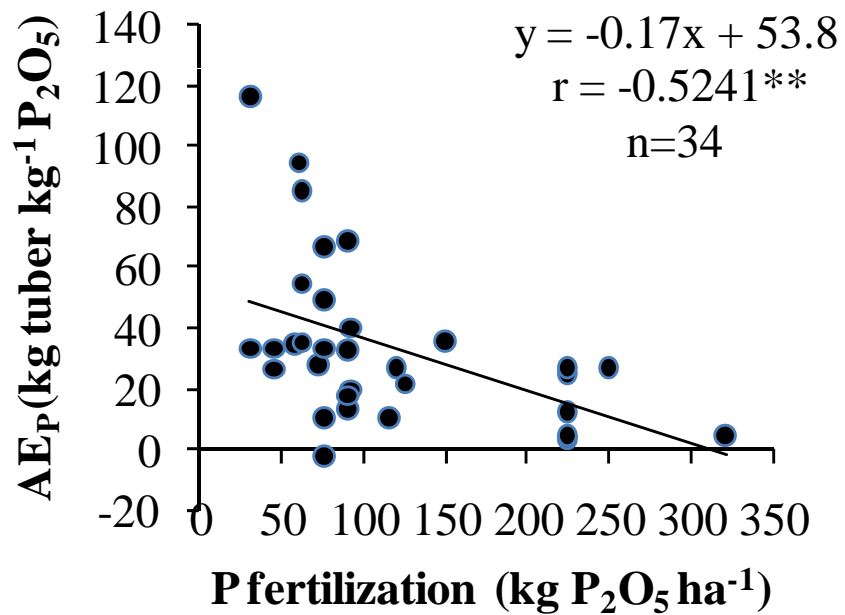
## Factors affecting nutrient use efficiency

- Nutrient rate

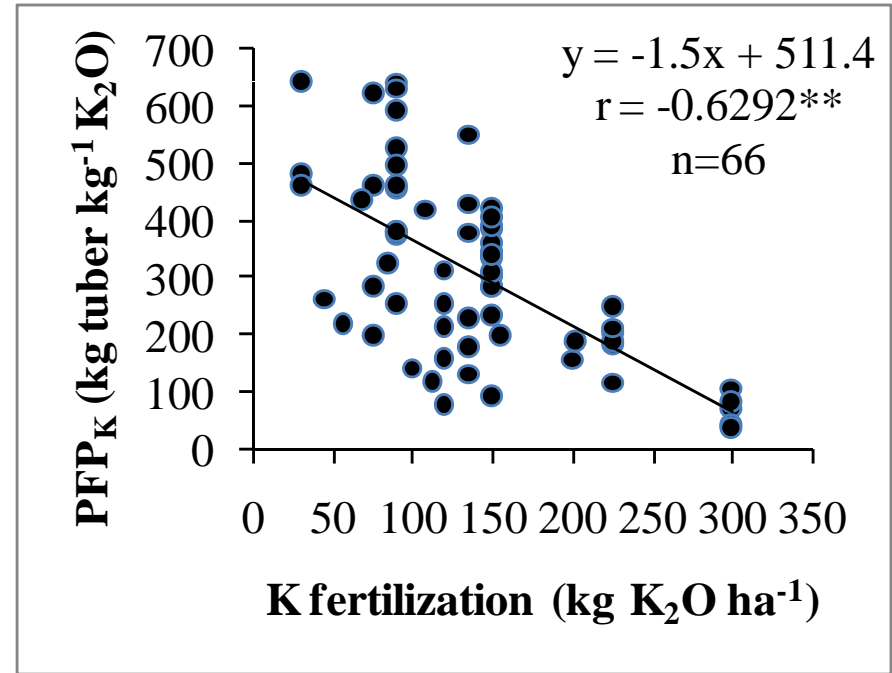
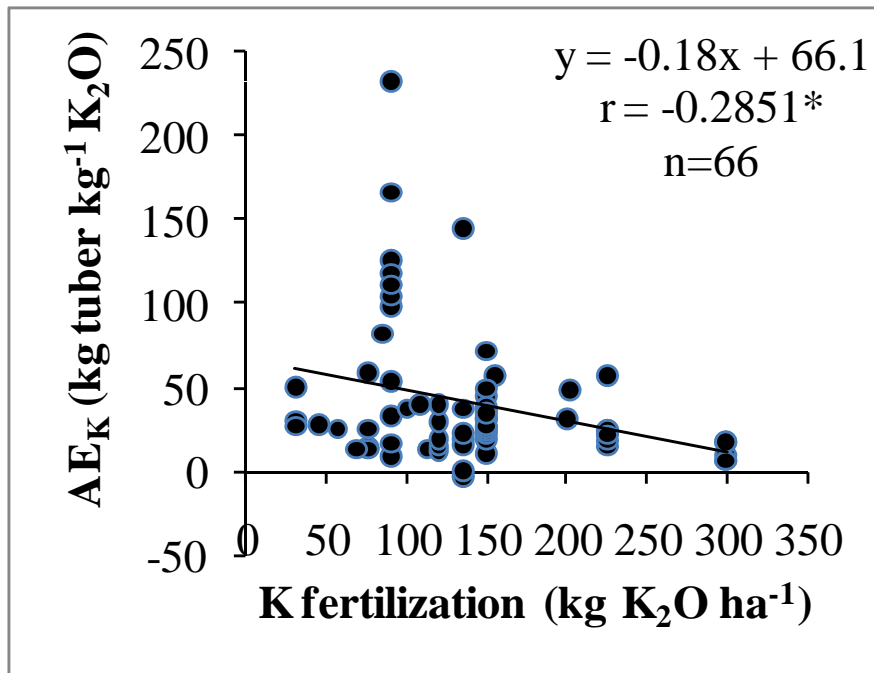
Relationship between nutrient N rates and use efficiency



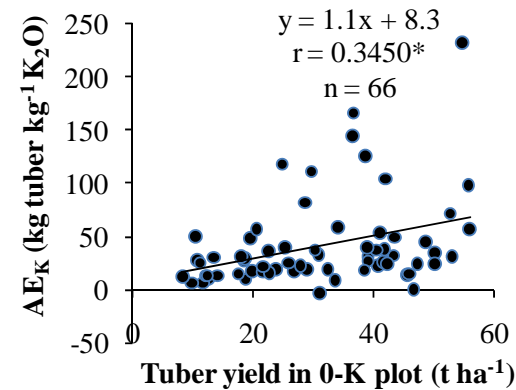
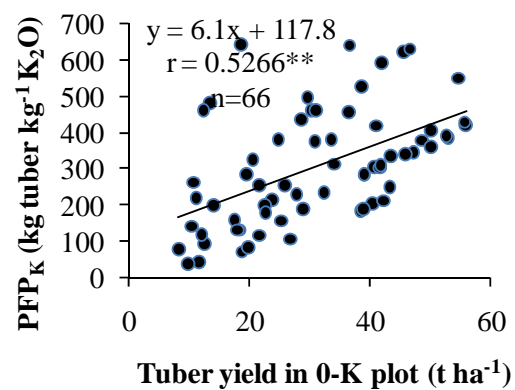
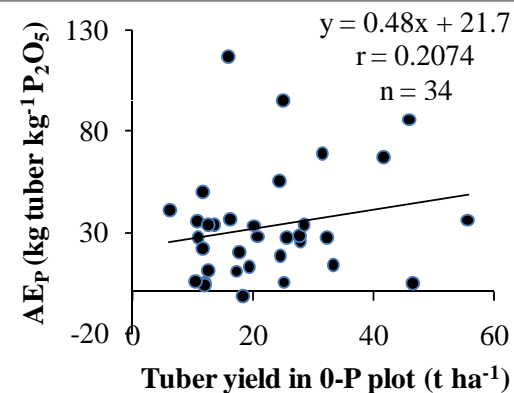
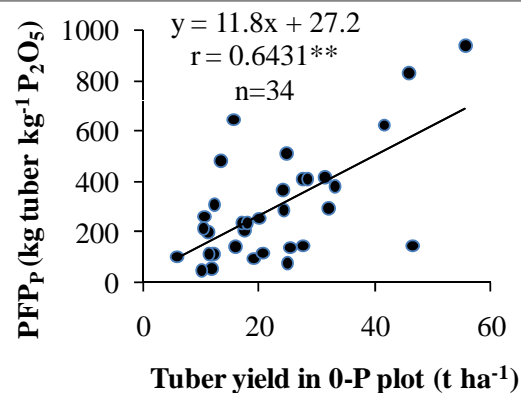
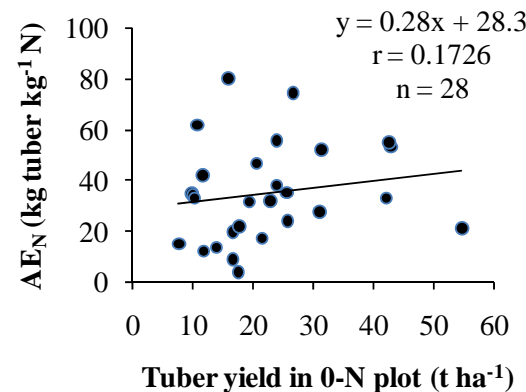
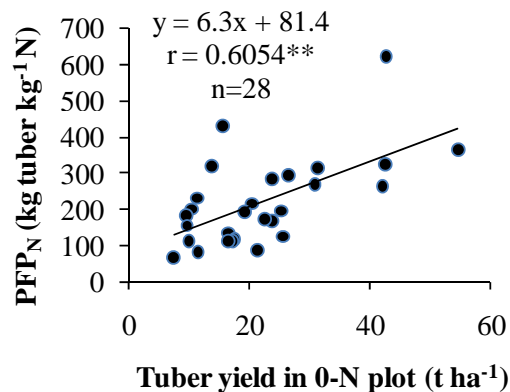
## Relationship between nutrient P rates and use efficiency



## Relationship between nutrient K rates and use efficiency



# Soil nutrient fertility

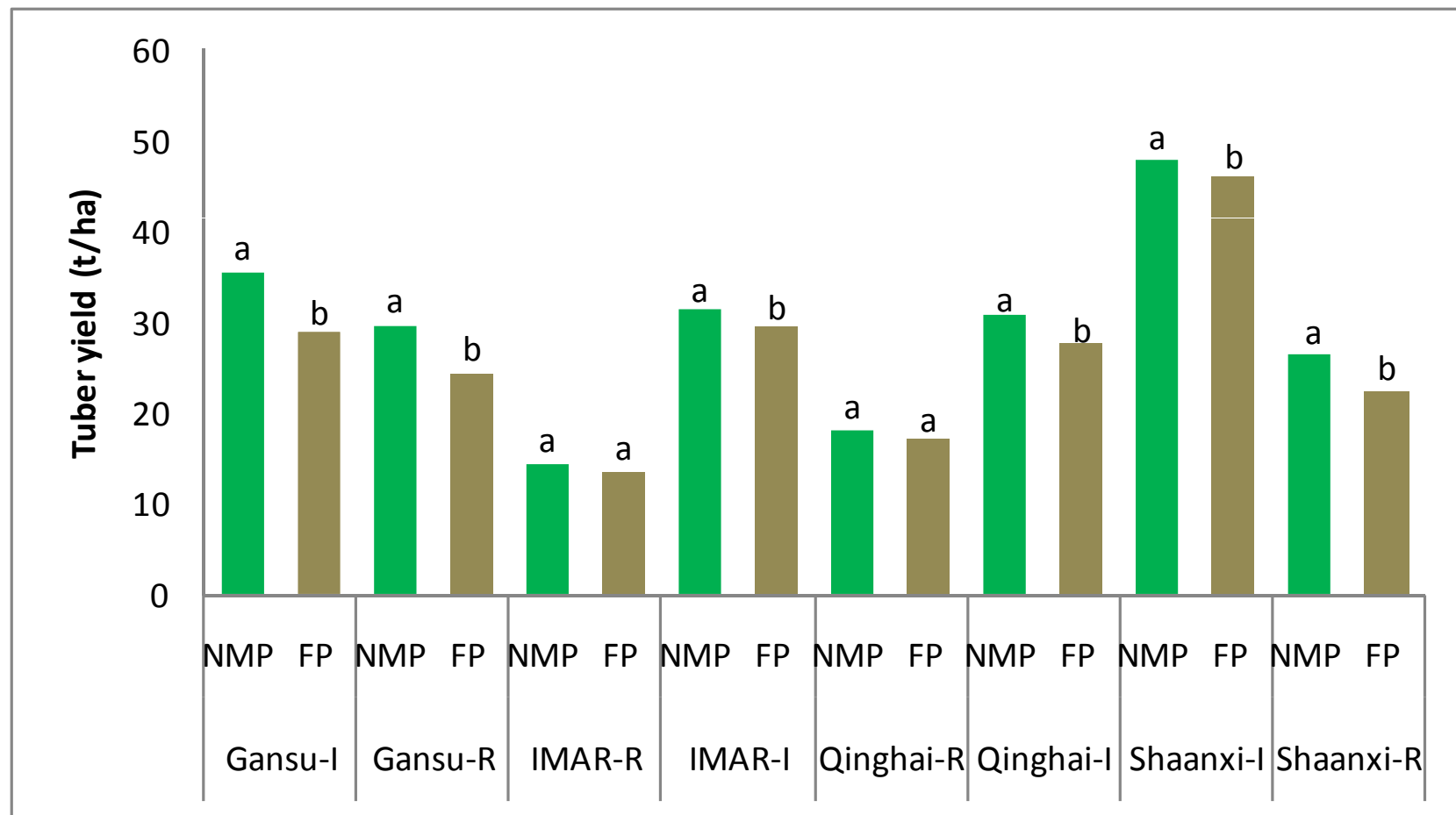


## Nutrient management evaluation



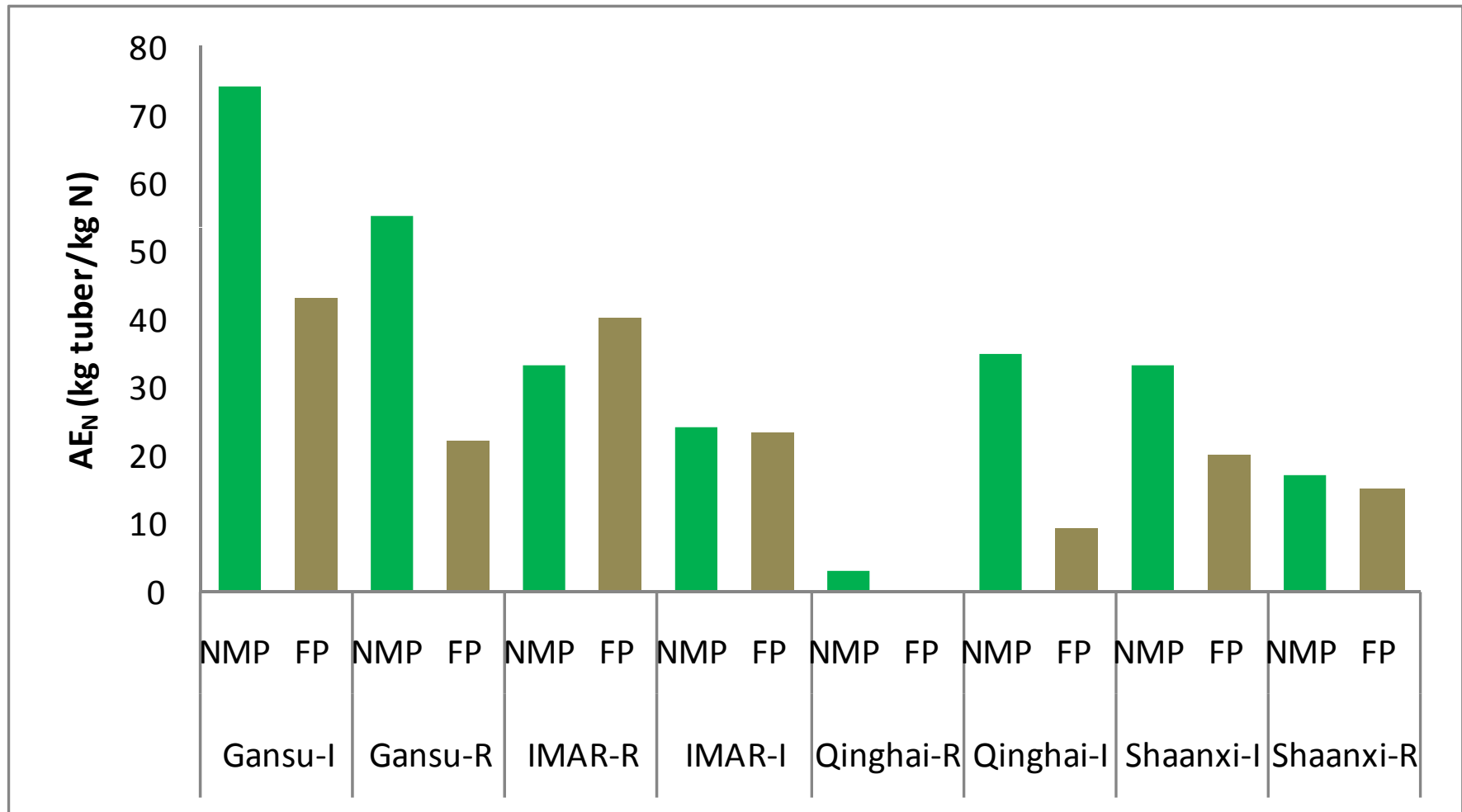
Location	Year	Treat.	N kg ha <sup>-1</sup>	P <sub>2</sub> O <sub>5</sub> kg ha <sup>-1</sup>	K <sub>2</sub> O kg ha <sup>-1</sup>
Gansu-Irrigated	2004	OPT	120	120	150
		FP	60	30	0
Gansu-Rainfed	2006	OPT	104	72	68
		FP	104	0	0
IMAR-Rainfed	2006	OPT	125	125	100
		FP	60	18	0
IMAR-Irrigated	2006	OPT	250	225	200
		FP	141	51	0
Qinghai-Rainfed	2007	OPT	158	75	135
		FP	240	52	90
Qinghai-Irrigated	2007	OPT	158	75	135
		FP	240	52	90
Shaanxi-Irrigated	2007	OPT	181	322	225
		FP	194	504	225
Shaanxi-Rainfed	2007	OPT	307	322	225
		FP	358	0	0

## Tuber yield of OPT plots increased over FP by 4.0% to 22.1%

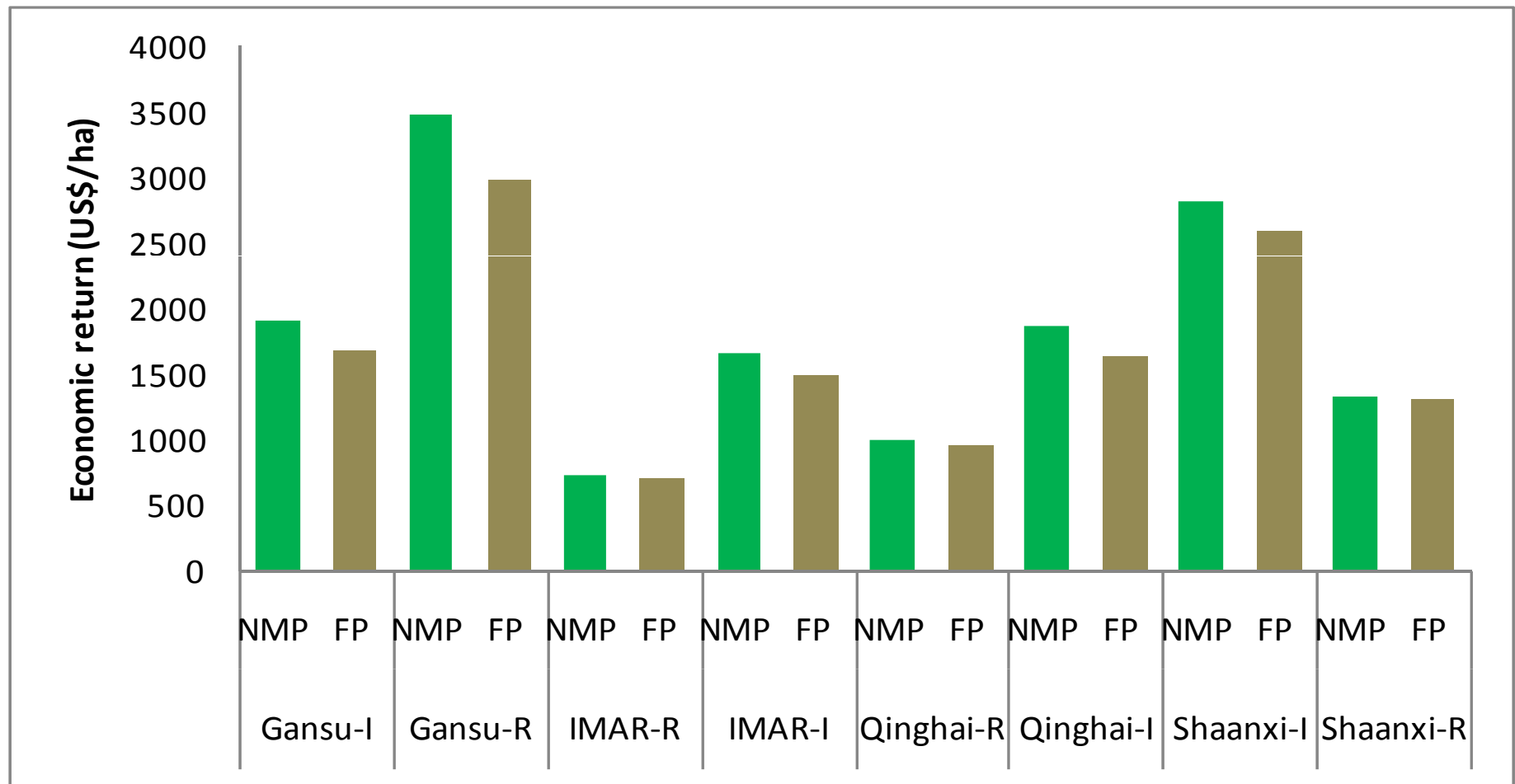


\* I: Irrigated , R: Rainfed

## AE of OPT over FP in most trials



## OPT over FP in economic return





# Research summary

- N deficiency is a general feature of rainfed and irrigated potato in northwest region, whereas P and K supply are equally limiting factors.
- Nutrient use efficiency can be affected nutrient rate applied and soil nutrient fertility
- OPT have great advantages in agronomic and economic aspects over FP.

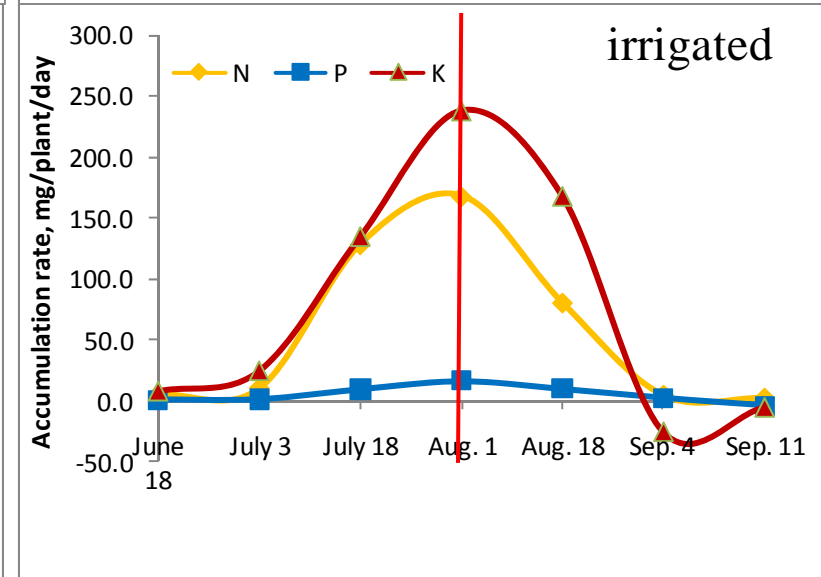
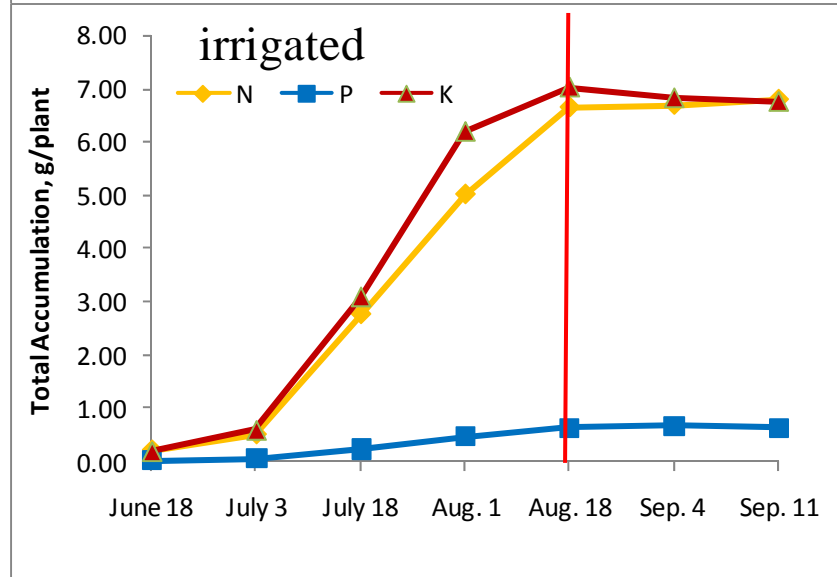
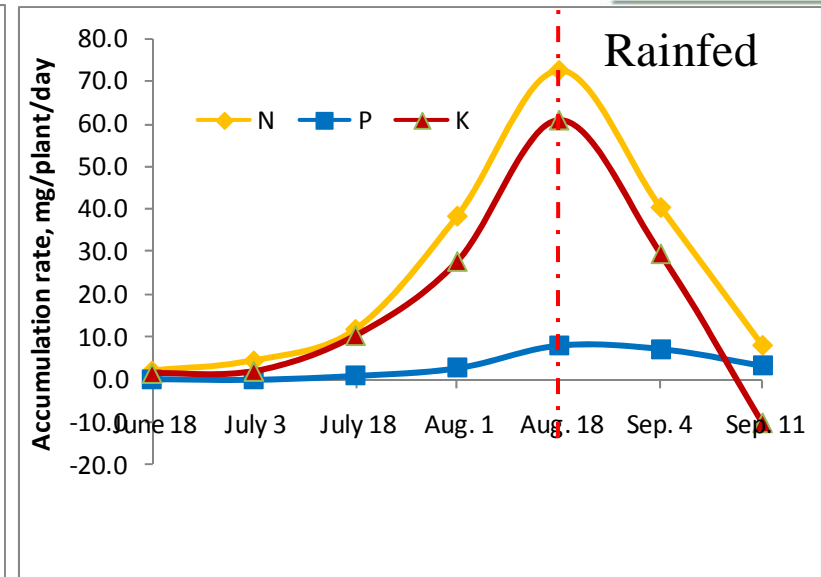
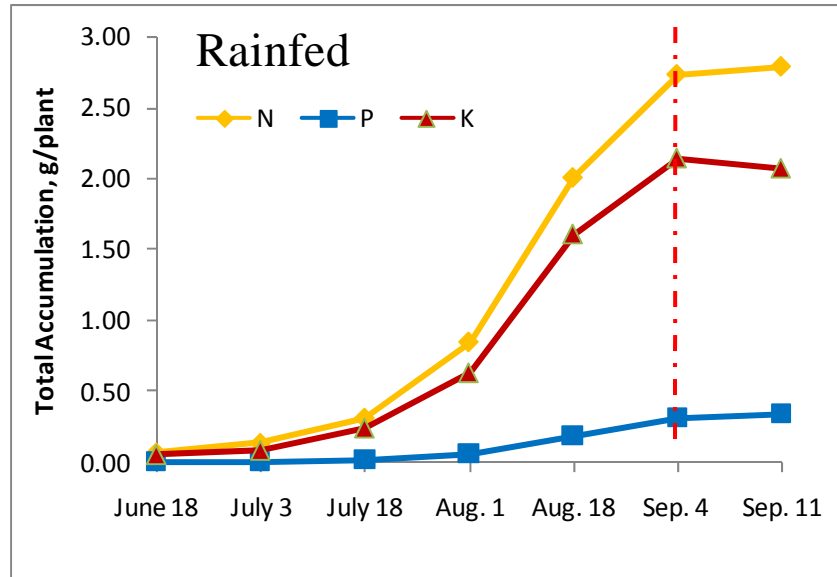
## Issues and challenges:

### Right source and place

- N, P and K sources
- Control release fertilizer?



# Right rate and time



A wide-angle photograph of a large agricultural field. The foreground and middle ground are filled with dense, green plants, likely a type of rose or similar shrub, many of which are in bloom with small, light pink and white flowers. In the background, a long, low brick wall stretches across the frame. Behind the wall, there is a line of trees and some white structures, possibly greenhouses or farm buildings. The sky is overcast and grey. The text "Thank you!" is overlaid in the center of the image in a blue, italicized font.

*Thank you!*