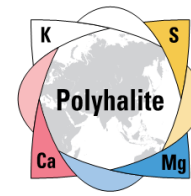




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SINCE 1952



IPI's first symposium on Polyhalite  
31 Oct. 2017, Sanya, Hainan

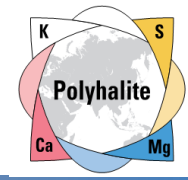
# The nutrient release kinetics of Polyhalite and its biological effect on tea growth and quality in China

Kang Ni, Qunfeng Zhang, Jianyun Ruan

Tea Research Institute, Chinese Academy of Agricultural Sciences

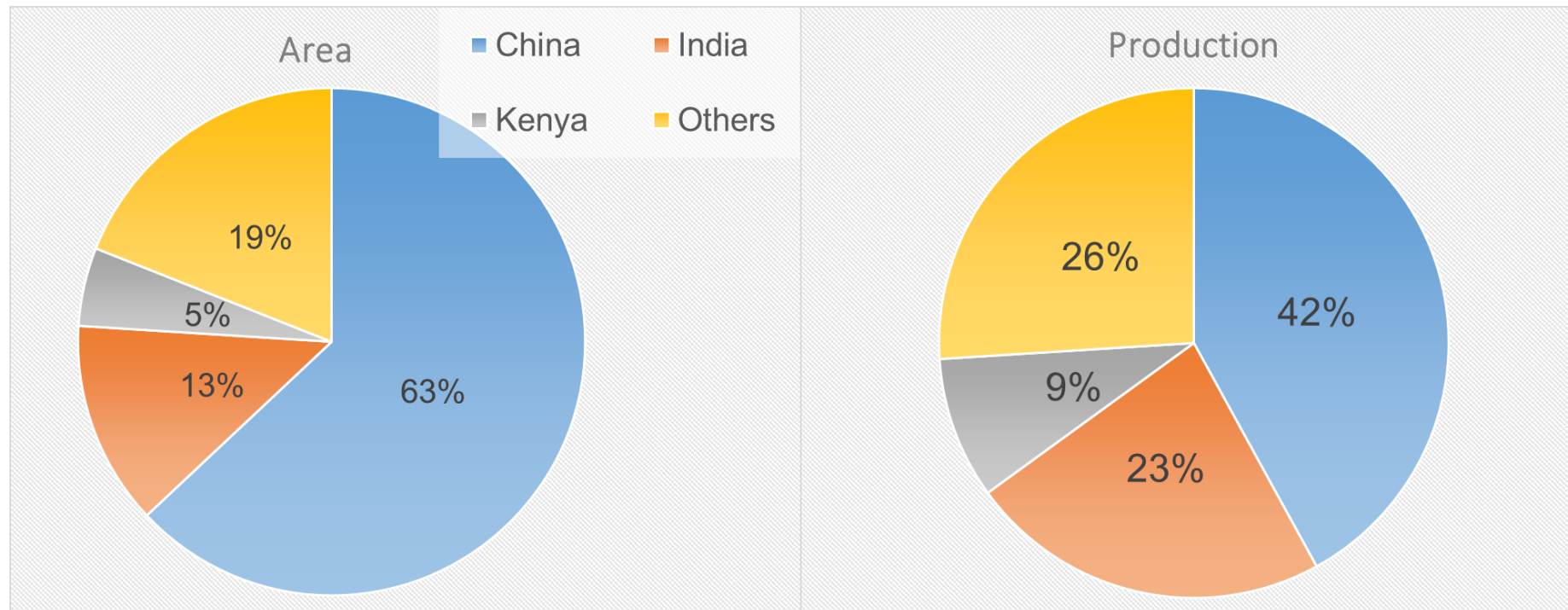


# Background

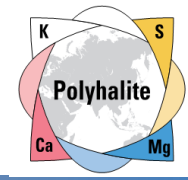


China is the largest tea production country in the world

**(Area 2.8 M ha, 63%; 517 M ton, 42%)**

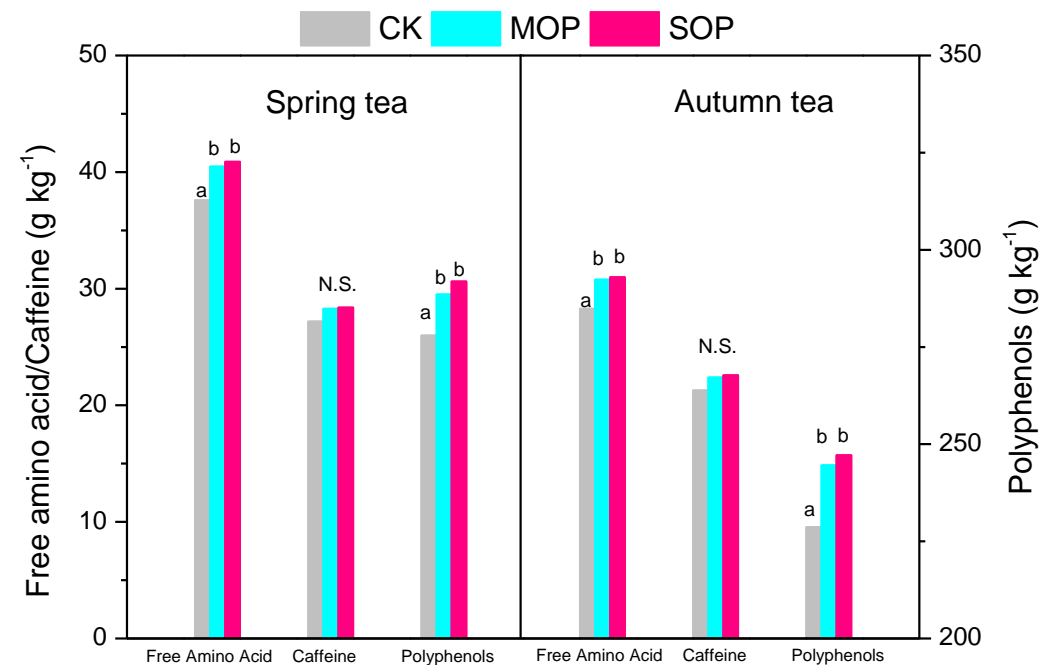
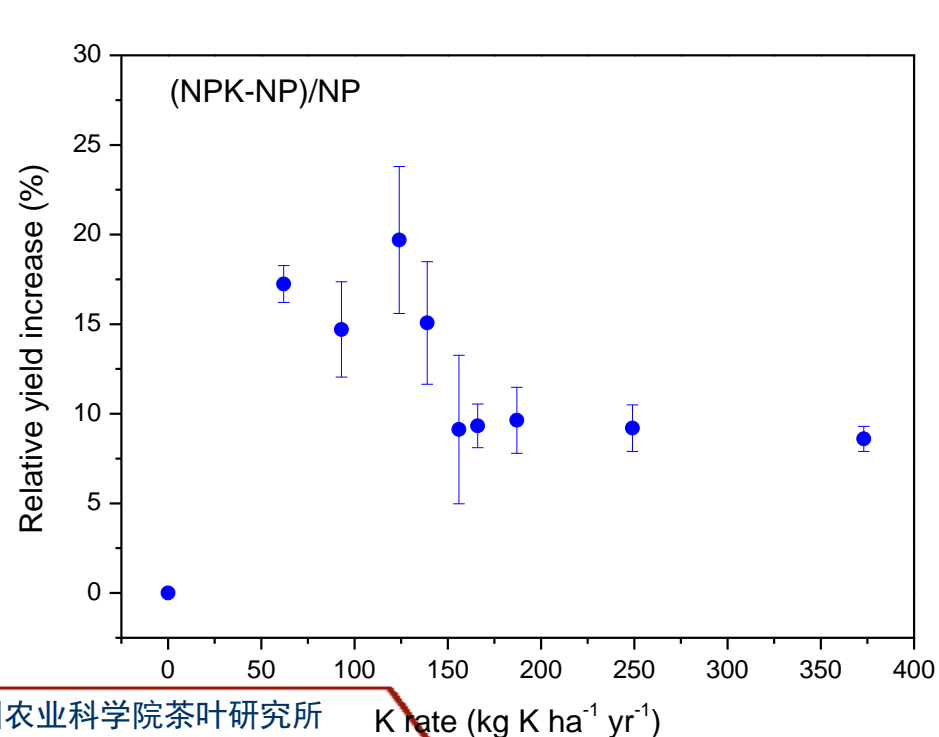


# Background

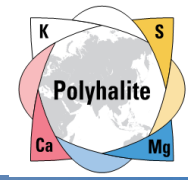


Beside N, K is also crucial in tea plantation

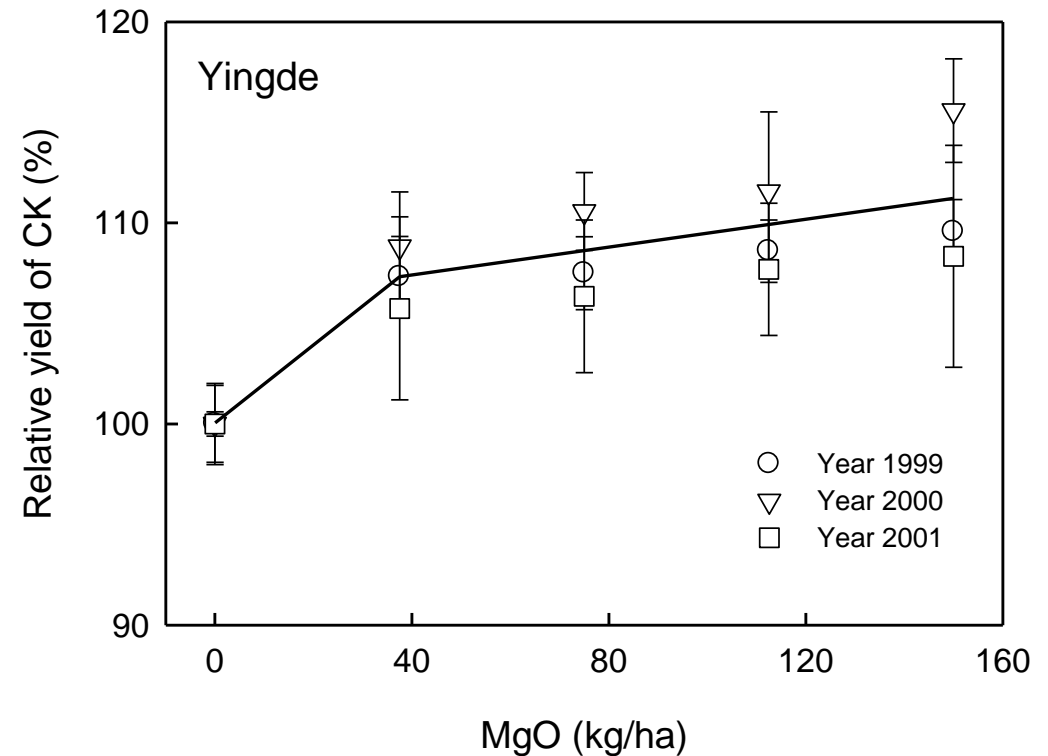
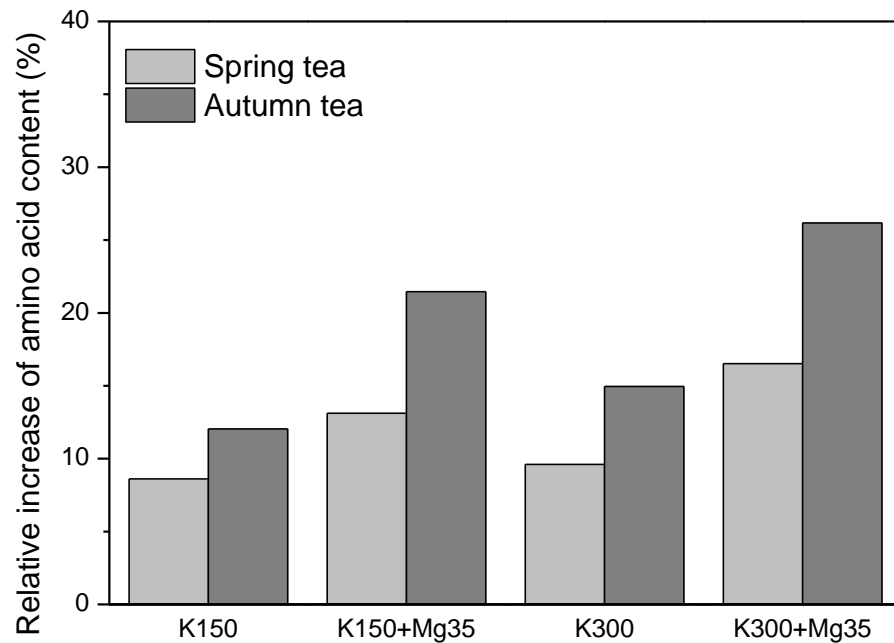
- **K increase fresh yield**
- **Favors the accumulation of free amino acid and polyphenols**
- **Tolerance of drought, frost and other stress (insects, fungal etc.)**



# Background

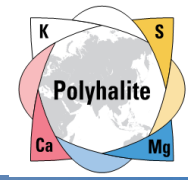


- ❖ Mg fertilization increase ~5% tea yield
- ❖ Increase amino acid content in Green, Black and Oolong tea
- ❖ Synergetic effect on K

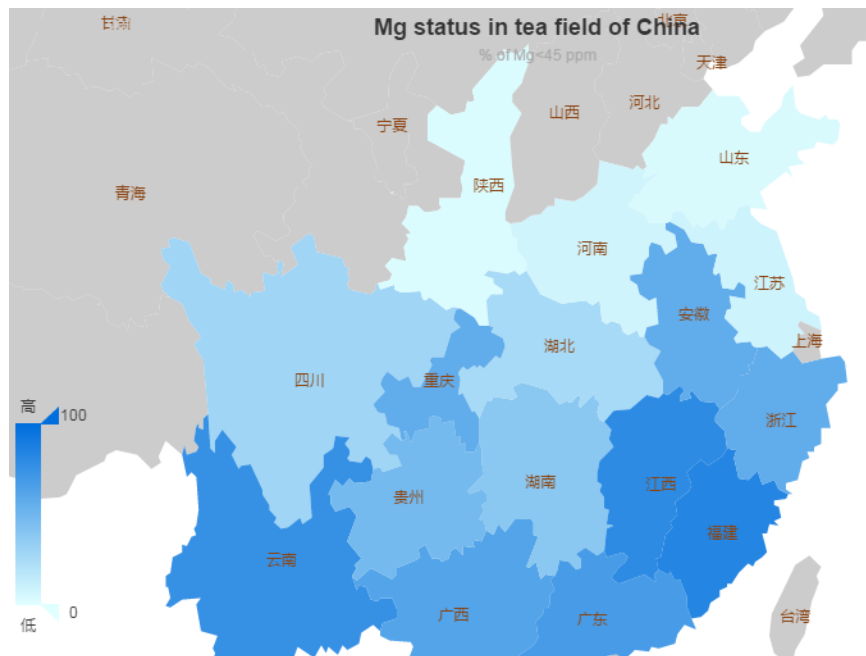


(Ruan et al., 1999)

# Background



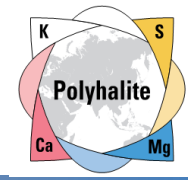
- Low CEC, acidic properties of soil plantation soil
- Exch.K ranged 15.3~1031 mg/kg, ~75% less than 100 mg/kg
- Exch.Mg ranged 10~80 mg/kg, ~62% less than 45 mg/kg



>80% of tea gardens in Yunnan, Jiangxi and Fujian in Mg deficiency (<45 mg/kg)

K and Mg supply is crucial for sustainable of tea production

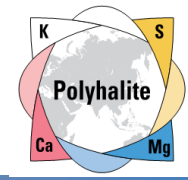
# Background



## Polyhalite application in tea plantation

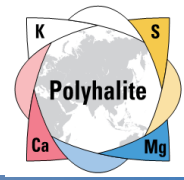
- **Natural mineral**
- **Four elements in one fertilizer (K, Mg, Ca, S)**
- **Labor-cost saving (less separated fertilization)**
- **Slow-release (lower solubility)**
- **Without Cl toxicity**
- **Mitigate soil acidification (Ca)**
- **Surplus Ca addition (affect Mg uptake)**
  - **Ca > 500 mg kg<sup>-1</sup> reduce quality**
  - **Ca > 2000 mg kg<sup>-1</sup> harm the growth**
  - **Ca > 5000 mg kg<sup>-1</sup> seriously inhibit the growth**

# Objectives



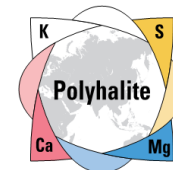
1. The K and Mg release of Polyhalite in tea plantation soil
2. The yield and quality effect of Polyhalite in green tea

# Questions



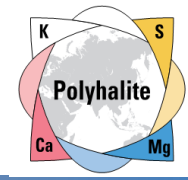
1. Does polyhalite has the slow-release nutrients in tea plantation soil?
2. Is there any advantage of Polyhalite on tea fertilization, compared with normal compound NPK?
3. Does addition of Ca by polyhalite have adverse effect on tea yield and quality?





# Laboratory leaching experiment

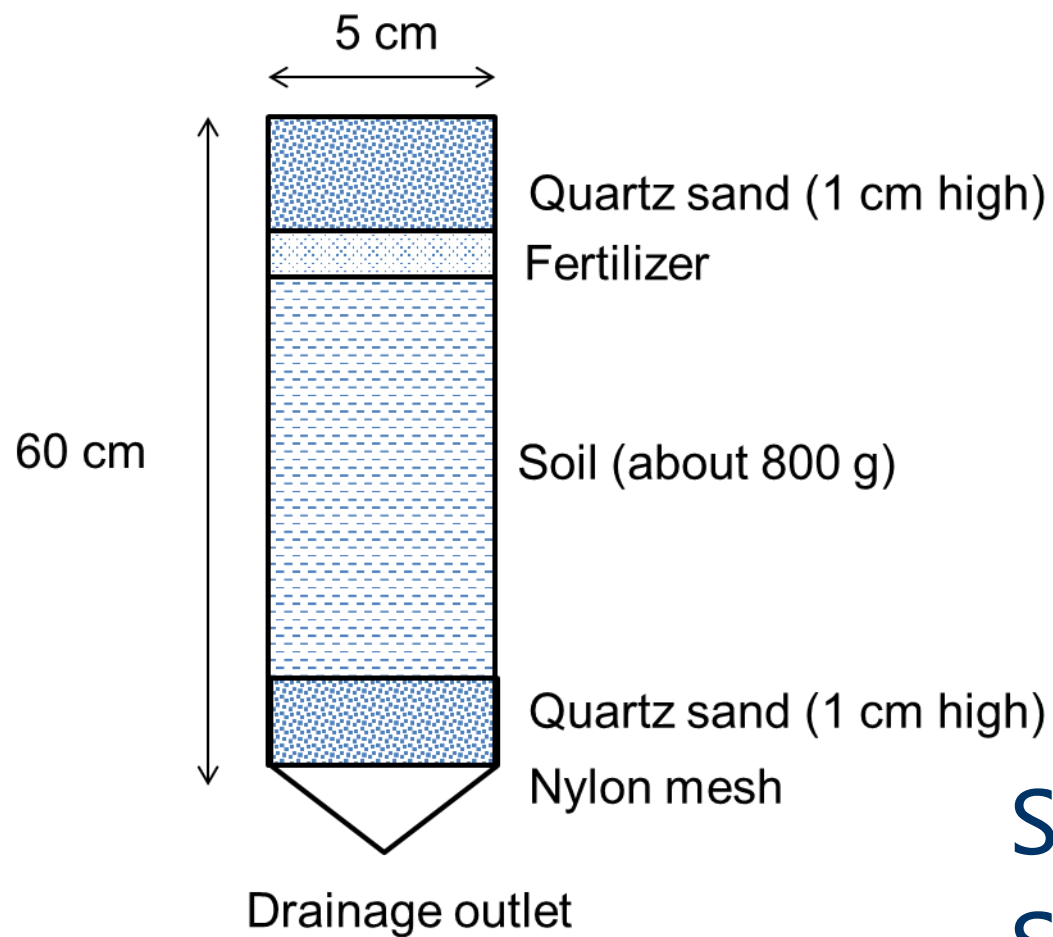
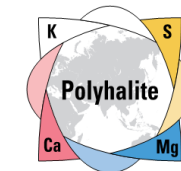
# Experiment design



Code	Explanations	
tr1	CK	Control
tr2	K	K addition
tr3	K+Mg	K and Mg addition (zero Ca)
tr4	PolyK	Polyhalite addition as the K in tr3, high Ca input
tr5	PolyMg+K	Polyhalite addition as the Mg in tr3, and K added to the level in tr 4
tr6	PolyMg	Polyhalite addition as the Mg in tr3, half Ca as tr4
tr7	K+Mg+Ca	K and Mg as tr3, but medium Ca addition between tr3 and tr 5

	Code	K (mg kg <sup>-1</sup> soil)	Mg (mg kg <sup>-1</sup> soil)	Ca (mg kg <sup>-1</sup> soil)
tr1	CK	0	0	0
tr2	K	100	0	0
tr3	K+Mg	100	20	0
tr4	PolyK	100	40	141
tr5	PolyMg+K	100	20	72
tr6	PolyMg	51	20	72
tr7	K+Mg+Ca	100	20	35

# Leaching Experiment

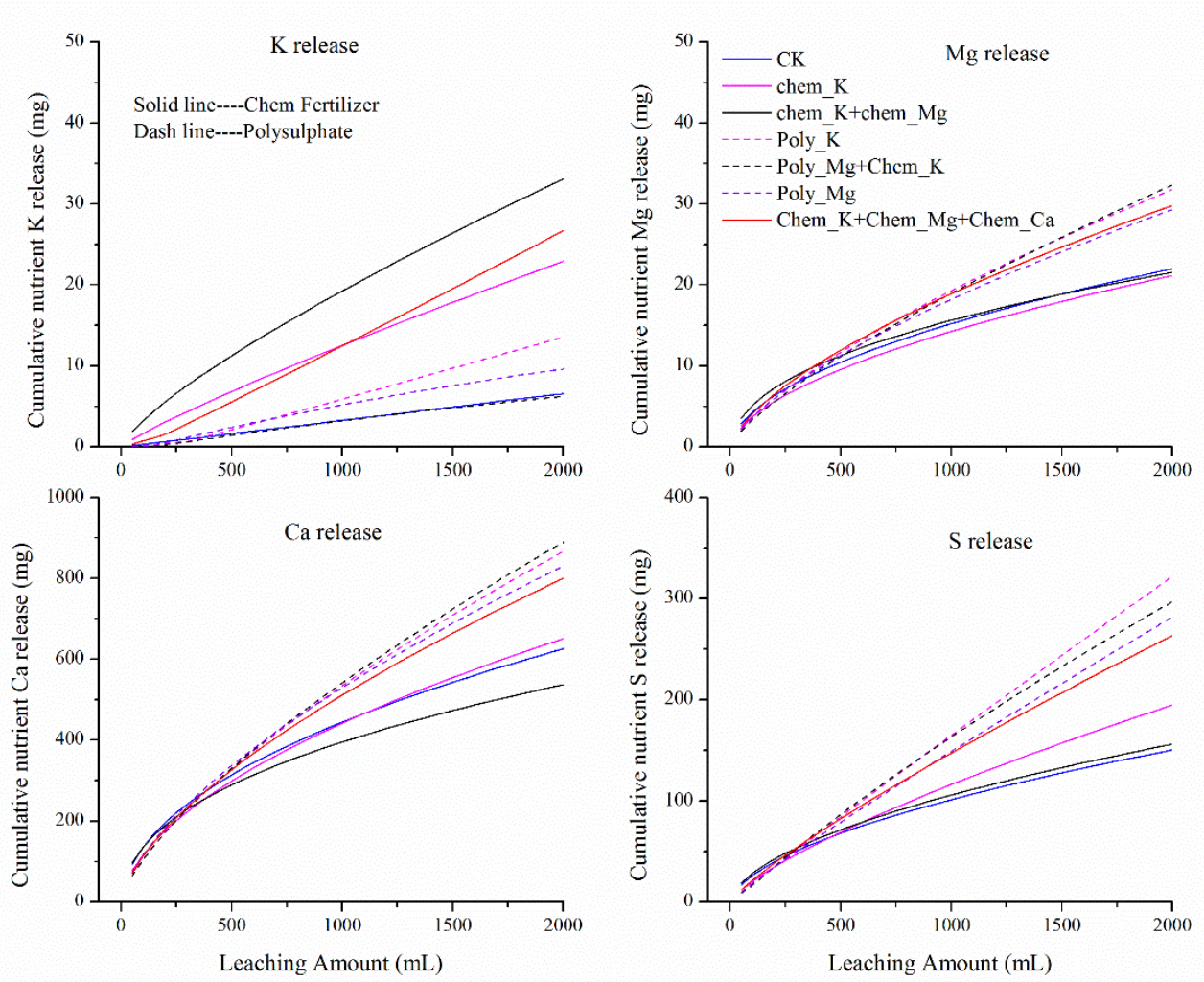
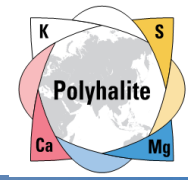


Soil pH 4.42

SOC 0.49%

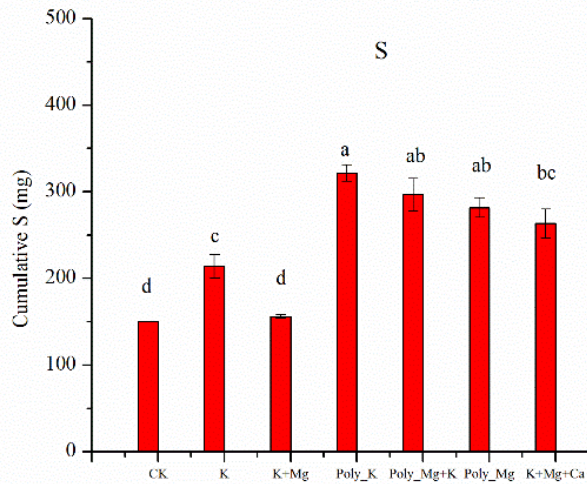
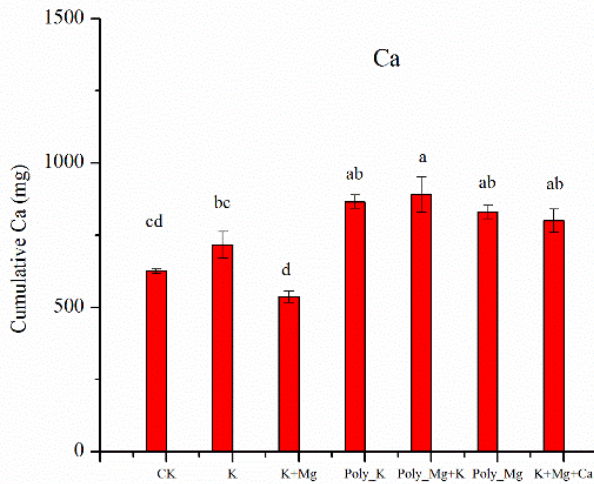
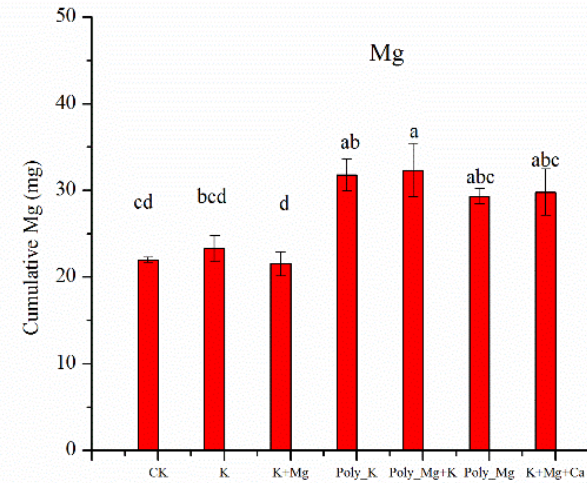
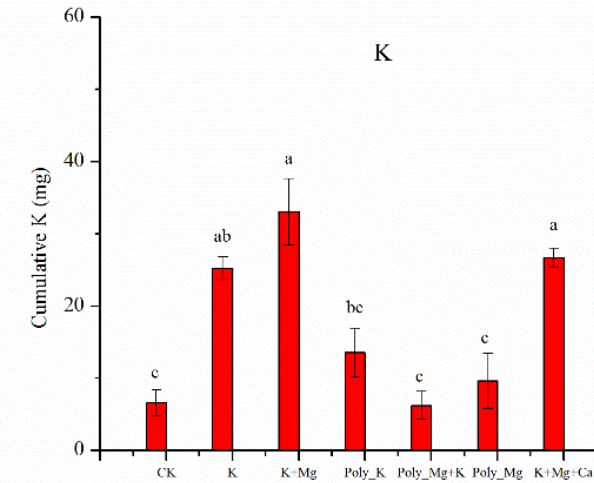
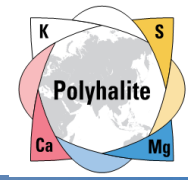
TN 0.07%

# Leaching experiment



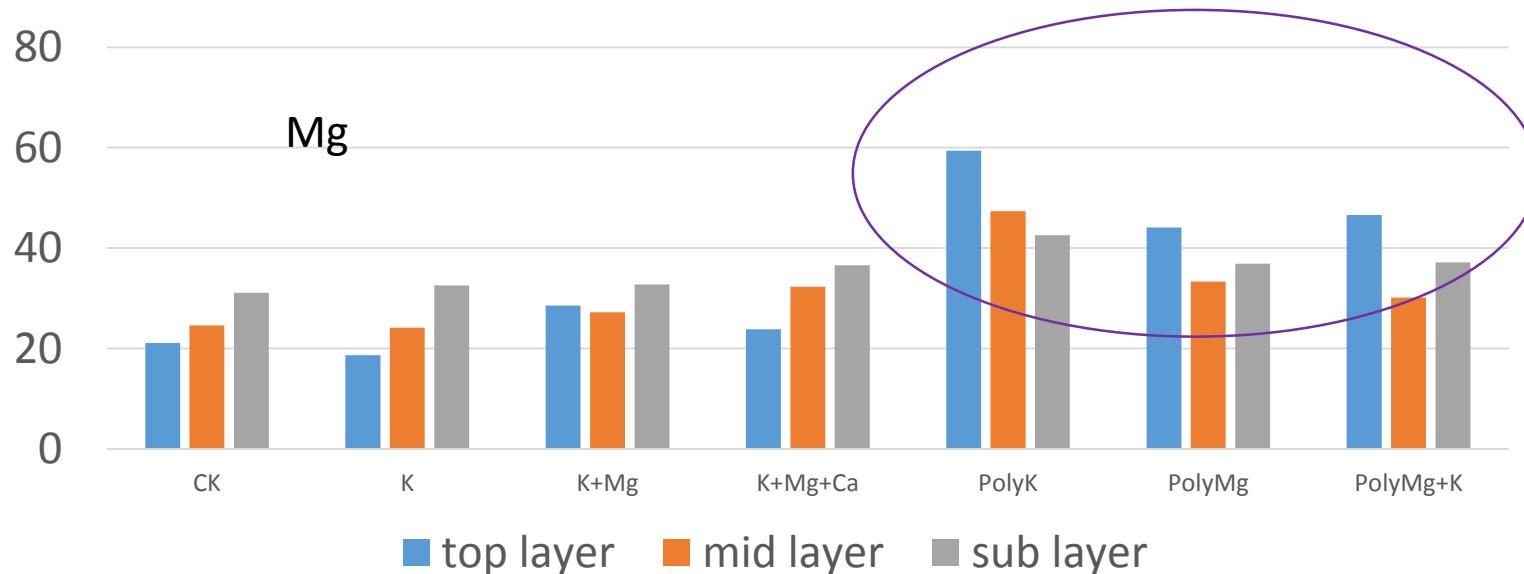
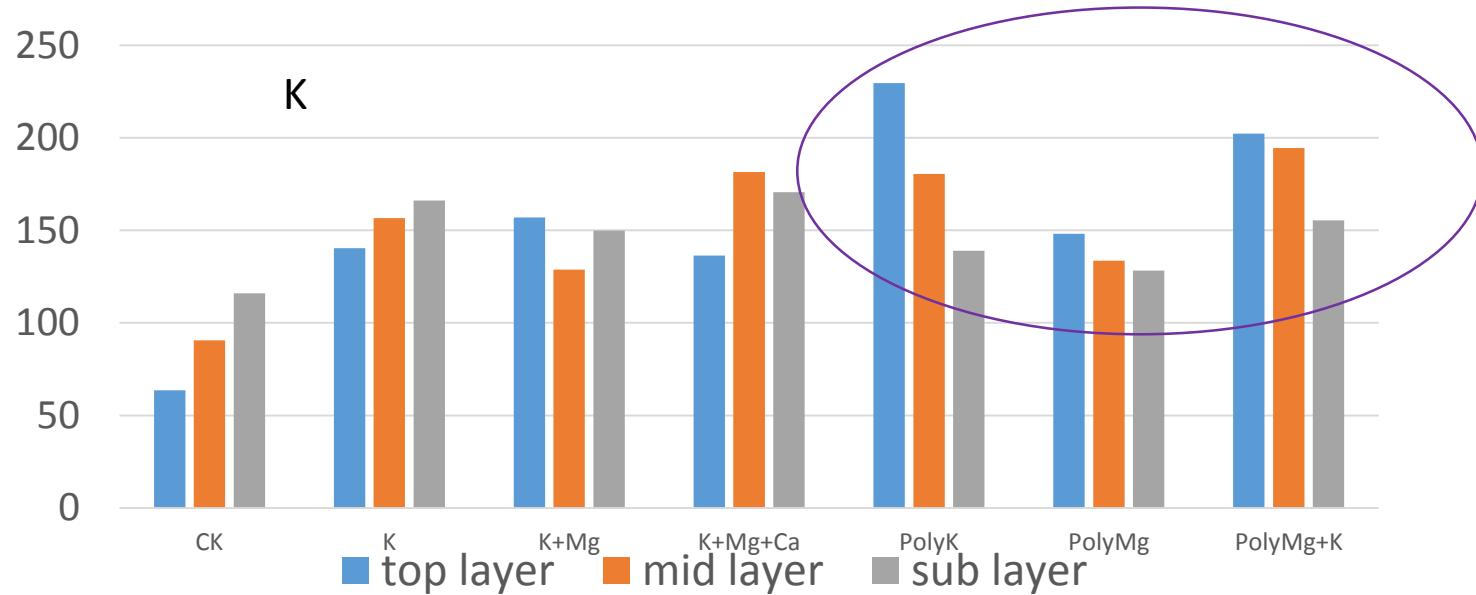
- Slow release of polyhalite

# Cumulative leaching

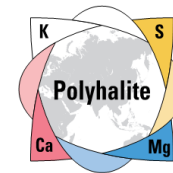


- Less leaching of cations
- High amount of anion of S (addition)

# K and Mg in the soil layers (mg kg<sup>-1</sup>)

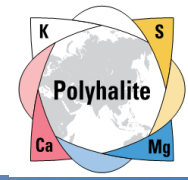


- High content in Poly
- Abundant in top layer
- Less downward
- Leaching reduction



# Pot experiment

# Pot experiment

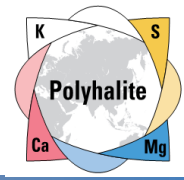


	Code	Explanations
tr1	CK	Control
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tr4	PolyK	Polyhalite addition as the K in tr3, high Ca input
tr5	PolyMg+K	Polyhalite addition as the Mg in tr3, and K added to the level in tr 4
tr6	PolyMg	Polyhalite addition as the Mg in tr3, half Ca as tr4
tr7	K+Mg+Ca	K and Mg as tr3, but medium Ca addition between tr3 and tr 5

处理	K	Mg	Ca
CK	0.00	0.00	0.00
K	90.00	0.00	0.00
K+Mg	<b>90.00</b>	<b>18.00</b>	0.00
PolyK	90.00	35.19	127.31
PolyMg+K	90.00	18.00	65.11
PolyMg	46.03	18.00	65.11
KMgCa	90.00	18.00	95.54



# Pot experiment



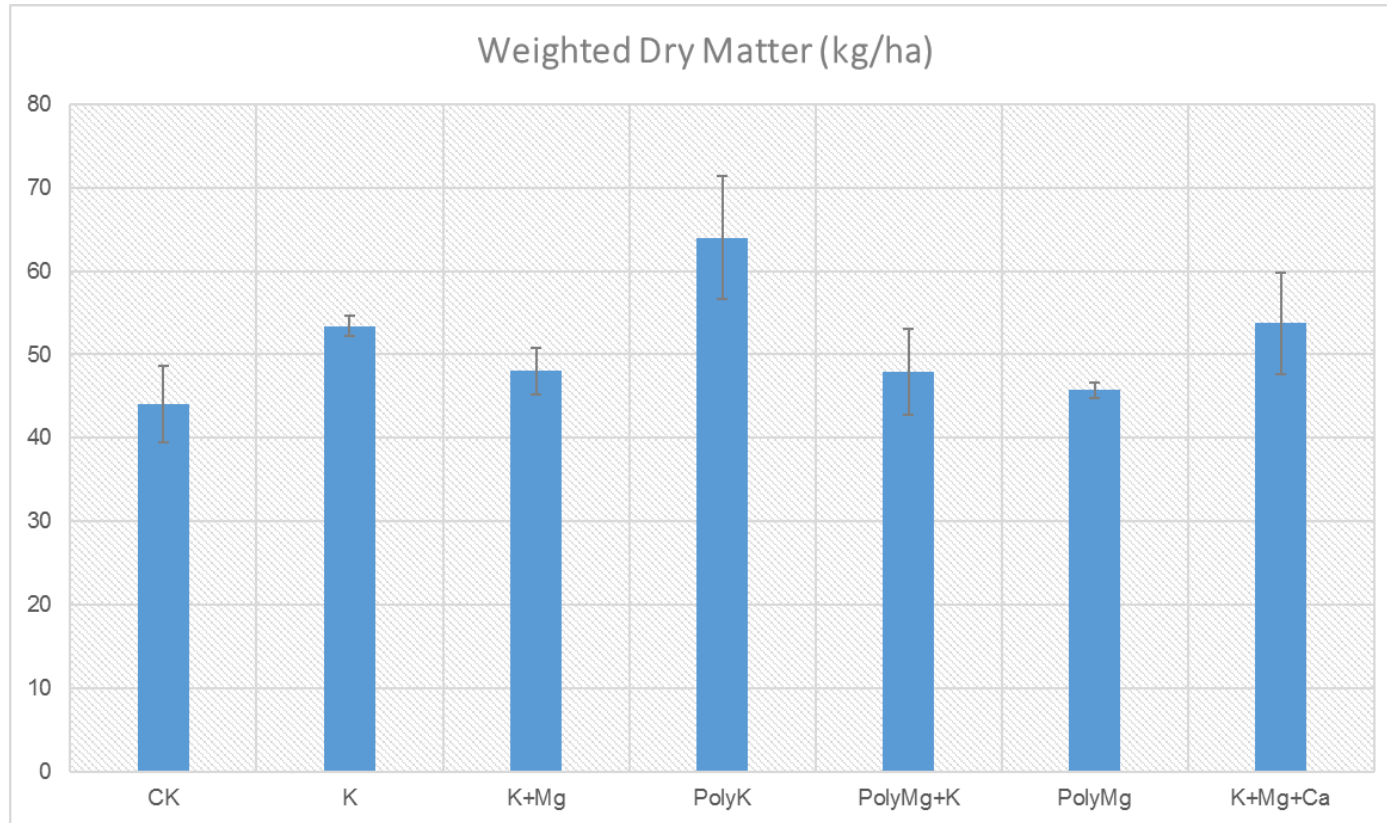
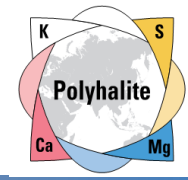
## ❖ Soil properties

- pH 5.3, SOC 0.81%, TN 0.08%
- Available P 0.6 mg/kg, Available K 71.9 mg/kg, Available Mg 26.6 mg/kg

## ❖ Variety

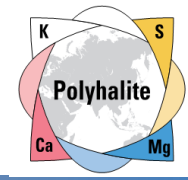
- Longjing 43

# Dry matter of young shoots

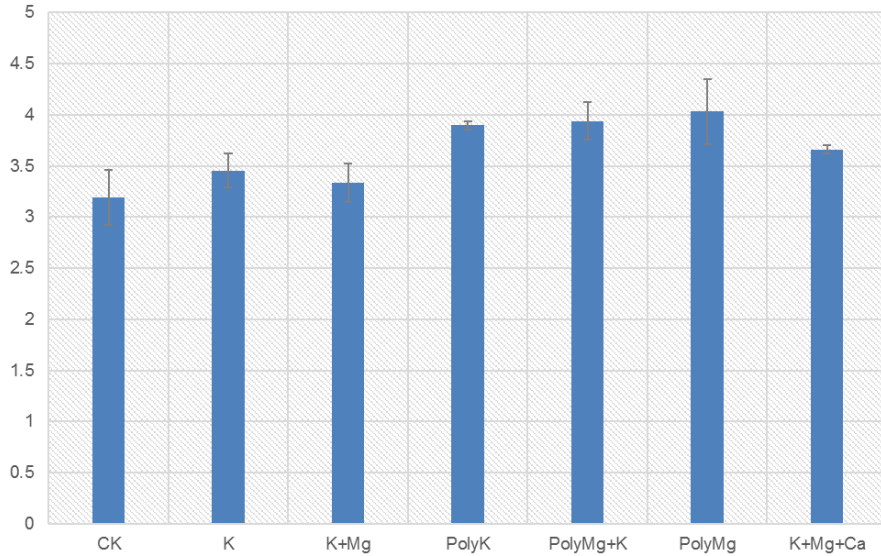


- highest yield in polyK, high Mg input?

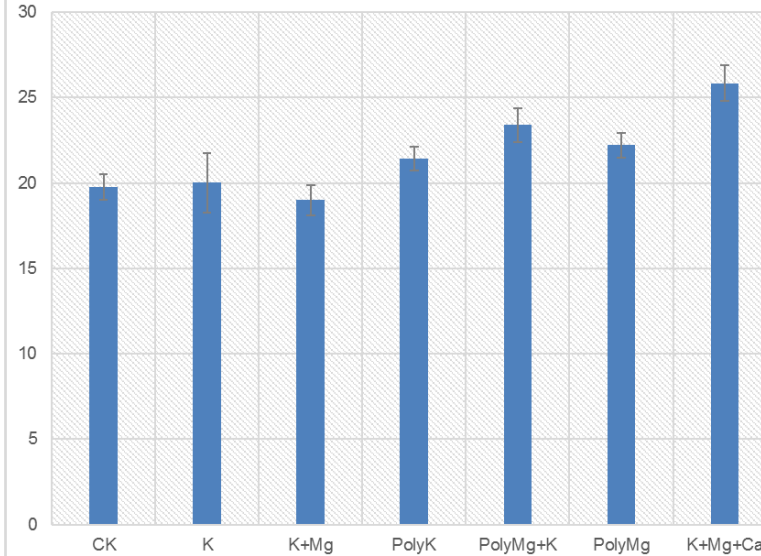
# Quality components



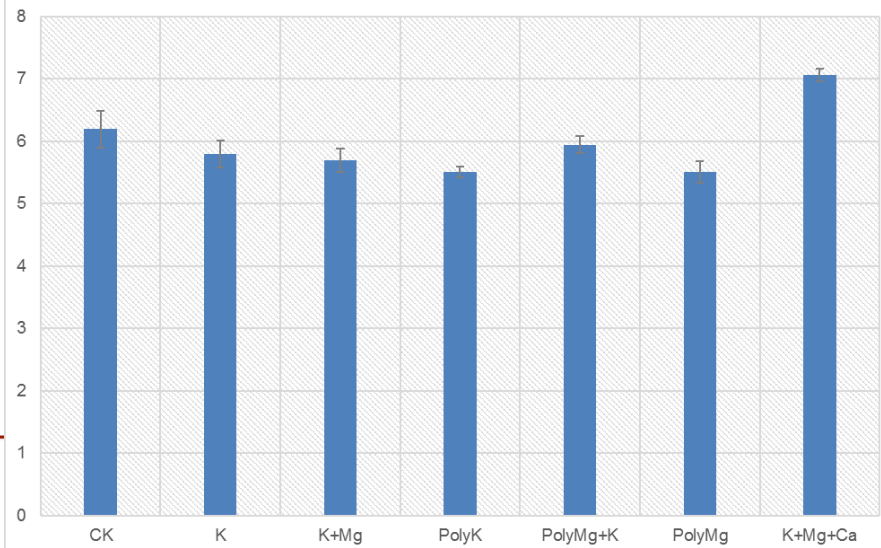
tea-amino acid%



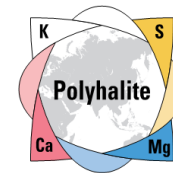
tea-polyphenol%



PP:AA

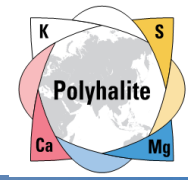


- Polyhalite addition significantly increased amino acid content
- CaSO<sub>4</sub> addition reduced the amino acid and increase the polyphenols, but polyhalite showed less effect



# Field experiment

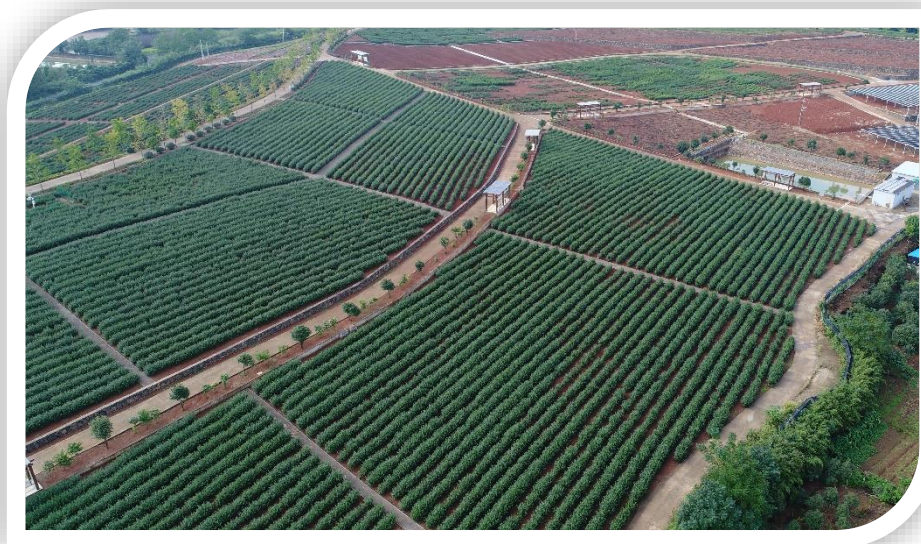
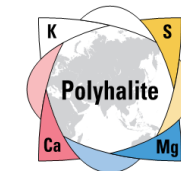
# Experiment design



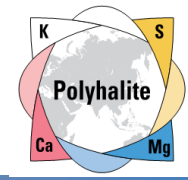
	<b>N1</b> (300 kg N ha <sup>-1</sup> )	<b>N2</b> (500 kg N ha <sup>-1</sup> )	<b>Comments</b>
<b>NPK</b>	-	-	-Mg
<b>NPKMg</b>	50 MgO	50 MgO	+Mg
<b>NPKMg+F</b>	20 MgO + MgSO <sub>4</sub> ·7H <sub>2</sub> O	20 MgO + MgSO <sub>4</sub> ·7H <sub>2</sub> O	+Foliar Mg
<b>Poly</b>	50 MgO	50 MgO	Polyhalite
<b>Compound</b>	50 MgO	50 MgO	Compound

10 treatments  
4 replicates  
Plot area: 56 m<sup>2</sup>

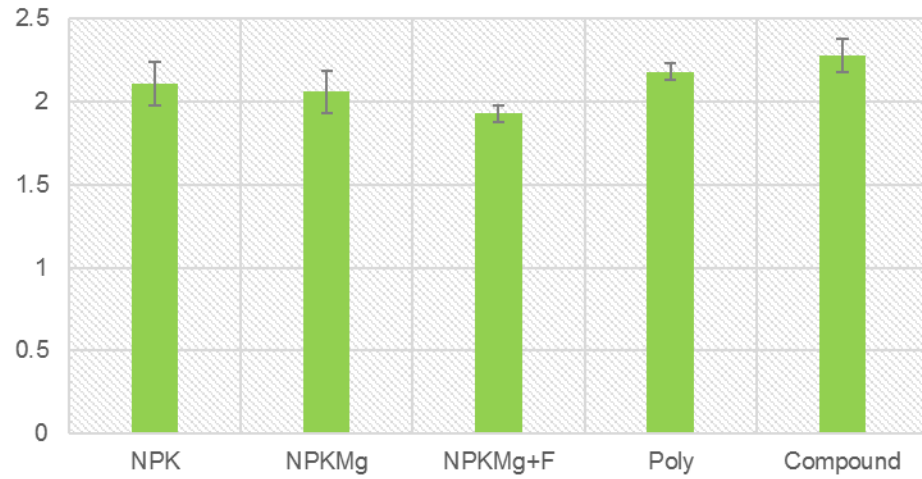
# Field Trial



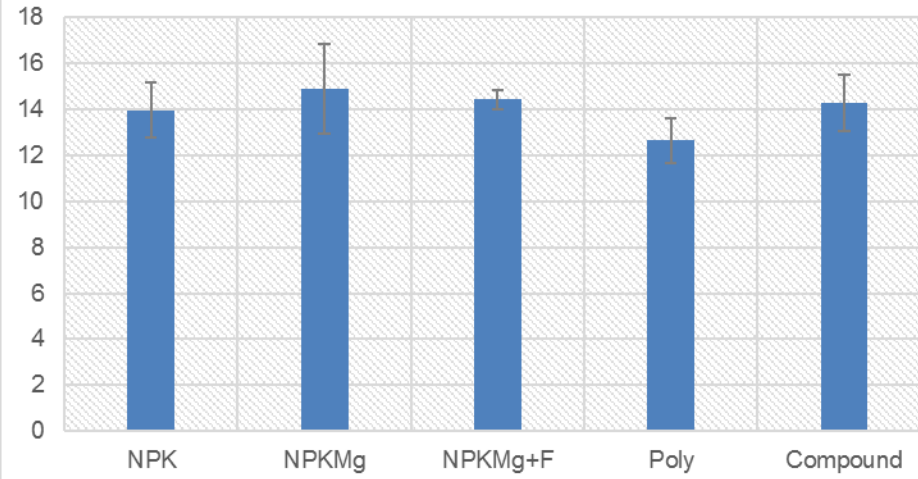
# N300



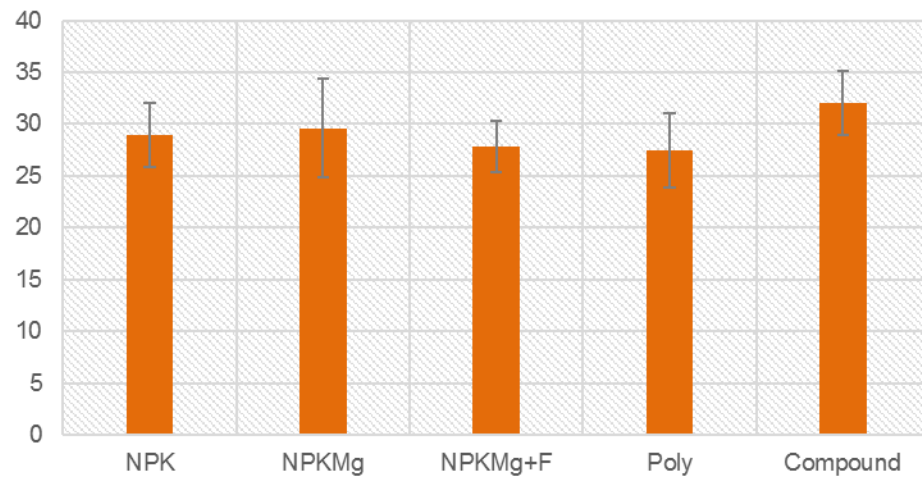
### Amino Acid (%)



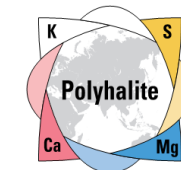
### PP:AA



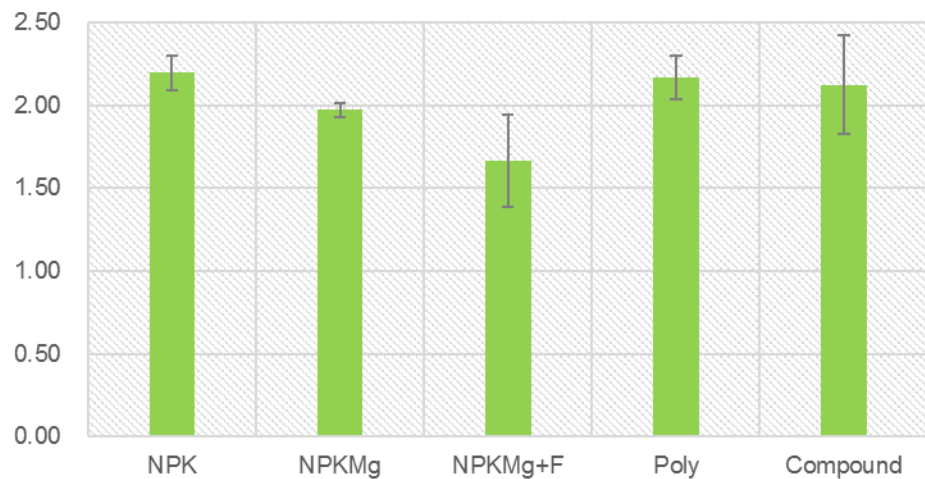
### Polyphenols(%)



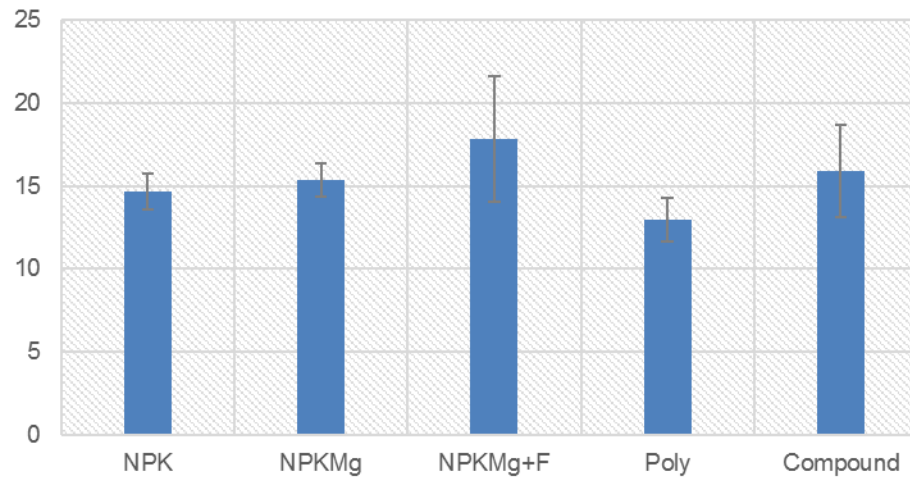
# N500



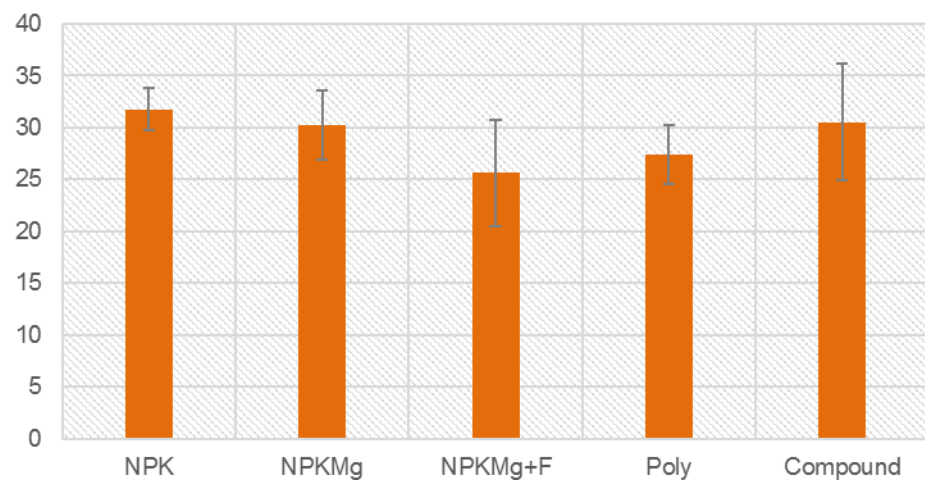
### Amino Acid (%)



### PP:AA

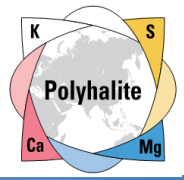


### Polyphenols(%)



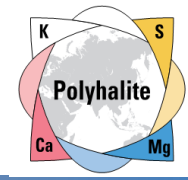


# Conclusion



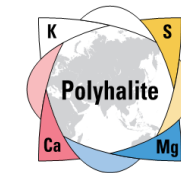
- Slow nutrient release of K, Mg and Ca in tea plantation soil
- Polyhalite has potential in nutrient leaching reduction
- Polyhalite slightly increased young shoot biomass
- Polyhalite addition increased the amino acid content and reduce PP:AA in spring tea
- Ca addition by polyhalite did not show adverse effect on autumn tea quality

# Acknowledgements



- Research group of Tea nutrition and physiology
- ICL and IPI
- Mr He Ming, Mr. Eldad Sokolowski and Dr. Li Guohua





# Thank you for your attention!

