INTERNATIONAL POTASH INSTITUTE
SINCE 1952

A New Potassium Fertilizer with Complete Secondary Nutrients
全中量元素解决方案

杂卤石在我国不同农作物上的肥效总结

Summary of effects of Polyhalite application on different crops in China

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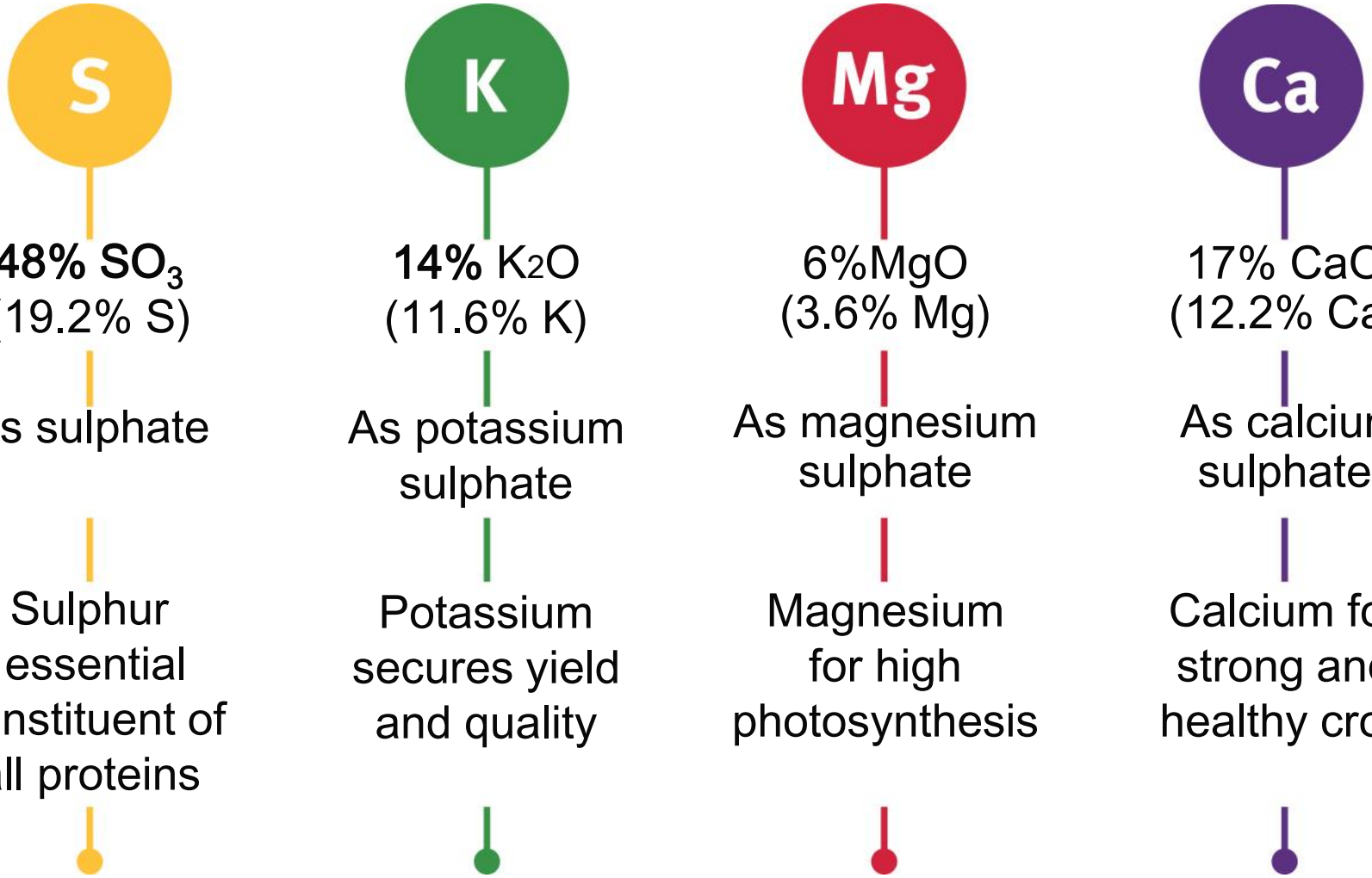
ICL Fertilizers
Where needs take us

2017年10月31日，三亚

31 October 2017，Sanya

Polysulphate

Roles of S, K, Mg, Ca in plants
硫、钾、镁和钙对作物的作用



硫酸钾钙镁—好在天然，贵在品质

1）纯天然，欧盟和美洲有机认证；

2）多养分，钾钙镁协同提效作用；

3）单晶体，性质稳定混配性优异；

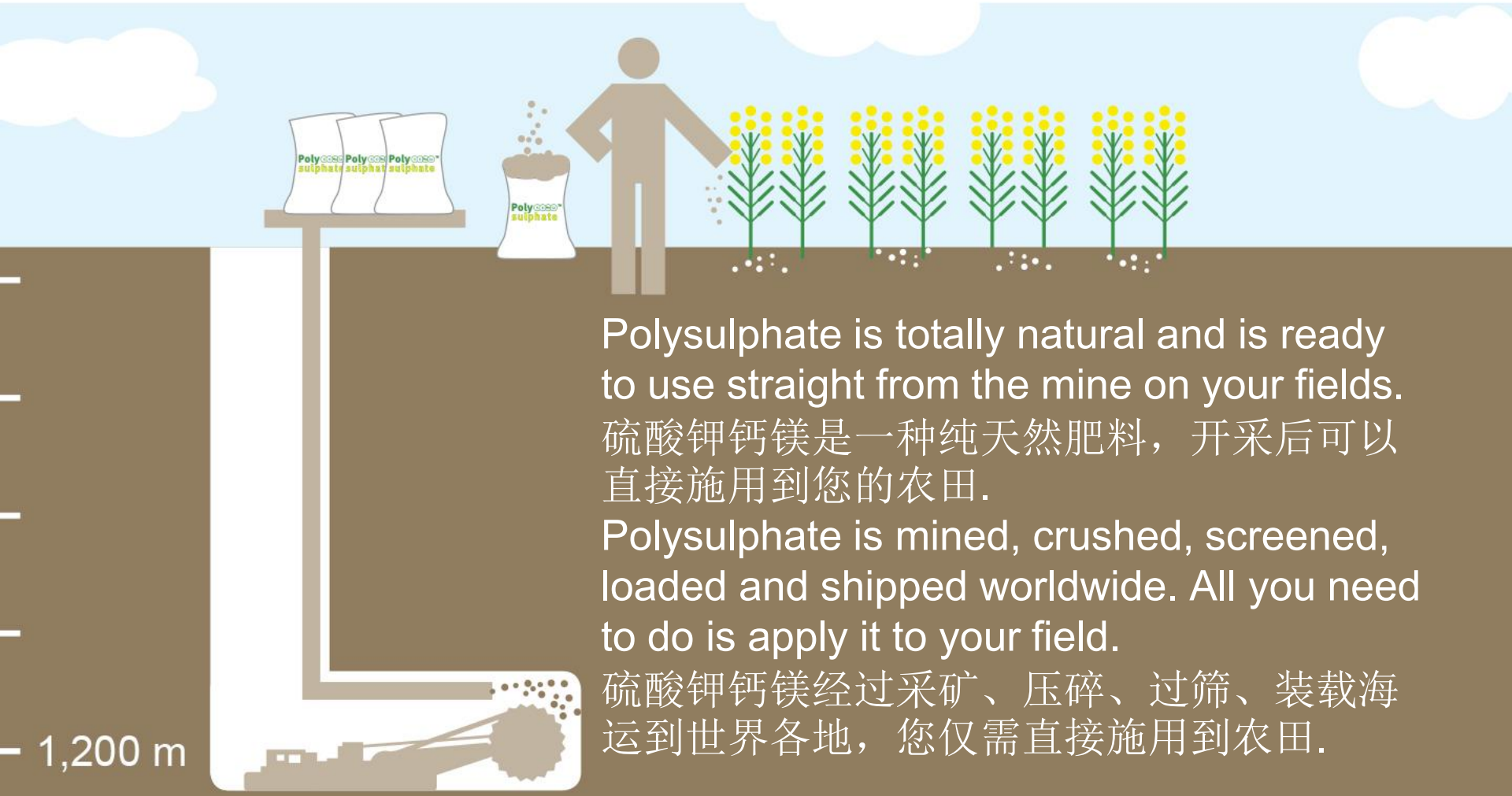
4）长效性，独特的养分持久释放；

5）淋洗少，养分当季利用效率高；

6）盐度低，适用于盐渍化的土壤；

7）含有硼，微量元素同补更高效；

纯天然—欧盟和美洲有机认证



Polysulphate is totally natural and is ready to use straight from the mine on your fields.
硫酸钾钙镁是一种纯天然肥料，开采后可以直接施用到您的农田.

Polysulphate is mined, crushed, screened, loaded and shipped worldwide. All you need to do is apply it to your field.
硫酸钾钙镁经过采矿、压碎、过筛、装载海运到世界各地，您仅需直接施用到农田.

纯天然—欧盟和美洲有机认证

Polysulphate is available in its natural form. The natural process by which Polysulphate is produced makes it a low carbon footprint fertilizer.
硫酸钾钙镁肥是一种纯天然，无任何化学添加的低碳环保的肥料.

U.K. Certified for organic farming by the Soil Association and the Organic Farmers and Growers since 2012
英国：2012年起获得土壤协会和有机农民和种植者的有机认证

E.U. Products are compliant with Regulation (EC) 889/2008 governing organic production
欧盟：产品符合(EC) 889/2008有机生产规程

USA Polysulphate Standard Grade is OMRI listed for organic use
美国：硫酸钾钙镁肥标准等级通过有机物质检查委员会认证

Germany Registered in the list of production facilities for organic farming in Germany by FiBL (Research Institute of Organic Agriculture)
德国：在有机农业的生产设备列表中注册

Canada Polysulphate Standard Grade is listed on the OMRI Canada products List
加拿大：硫酸钾钙镁肥标准等级通过有机物质检查委员会认证

Italy Product listed in the BIO fertilizers Italian register as per D. Lgs. 75/2010
意大利：产品列在有机肥料清单中，列单号D. Lgs. 75/2010

多养分—钾钙镁协同提效作用

FERTILIZER/肥料类型	S	K	Mg	Ca
Polysulphate/硫酸钾钙镁	⊕	⊕	⊕	⊕
Potassium sulphate cantaining magnesium salt 含镁盐的硫酸钾	⊕	⊕	⊕	
Potassium chloride cantaining magnesium salts 含镁盐的氯化钾		⊕	⊕	
Potassium magnesium sulphate 钾镁硫酸盐复合肥	⊕	⊕	⊕	
Potassium sulphate (SOP) 硫酸钾	⊕	⊕		
Kieserite/硫酸镁石	⊕		⊕	
Ammonium sulphate/硫酸铵	⊕			

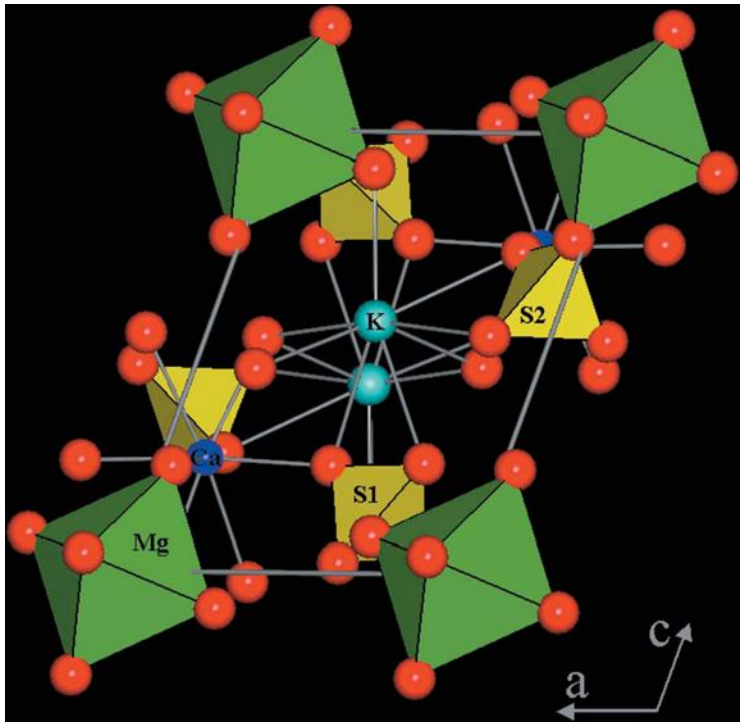
多养分—钾钙镁协同提效作用

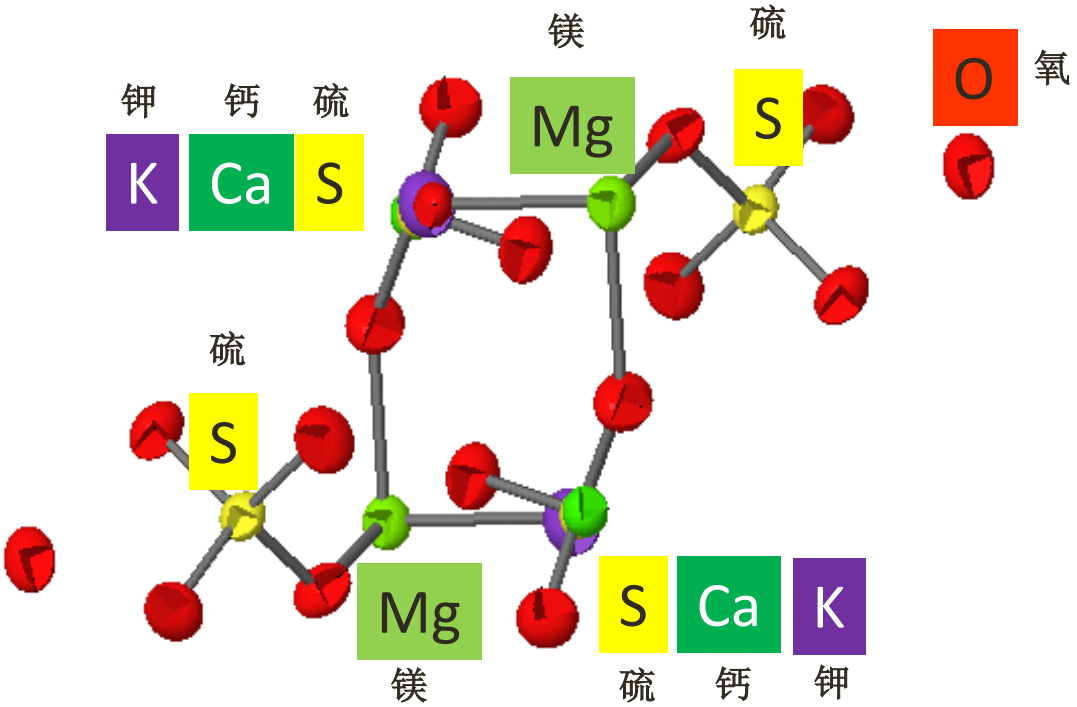
FERTILIZER/肥料类型	SO_3 (S)	K_2O	MgO (Mg)	CaO (Ca)	K_2O/MgO	CaO/MgO
	%					
Polysulphate/硫酸钾钙镁	48 (19.2)	14	6 (3.6)	17 (12.2)	**2.5/1**	**3-4/1**
Potassium sulphate containing magnesium salt/含镁盐的硫酸钾	42 (17)	30	10 (6)		3/1	
Potassium chloride containing magnesium salts/含镁盐的氯化钾	12.5 (5)	40	6 (3.6)		6.7/1	
Potassium magnesium sulphate1 钾镁硫酸盐复合肥1	53 (21)	22	18 (11)		1/1	
SOP/硫酸钾	45 (18)	50				
Kieserite/硫酸镁石	50 (20)		25 (15)			
Ammonium sulphate/硫酸铵	60 (24)					

Competition: As S source, Polysulphate is a full alternative/作为硫源，硫酸钾钙镁完全可以替代其它肥料.
K/Mg ratio in Polysulphate is similar to Potassium sulphate containing magnesium salt.Polysulphate contains also Ca/硫酸钾钙镁中的K/Mg比例与含镁盐的硫酸钾相似，但是硫酸钾钙镁还含有Ca.

单晶体—性质稳定混配性优异

$K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$ 硫酸钾钙镁的化学式





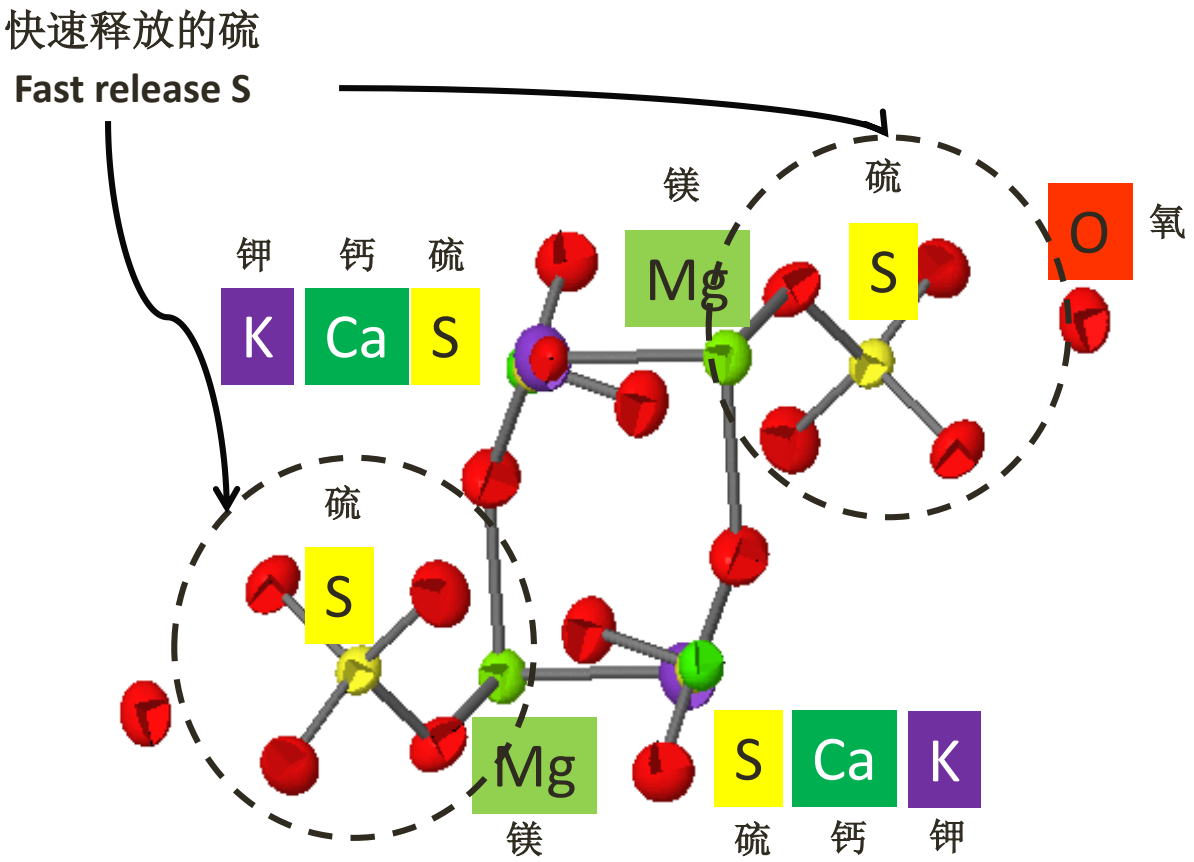
Luca Bindi. (2005) Reinvestigation of polyhalite, K2Ca2Mg(SO4)4-2H2O. Acta Cryst, E61, i135–i136.

http://publcif.iucr.org/cifmoldb/gui/cifjmol.php?cifid=wm6074

硫酸钾钙镁-钻石般的品质

长效性—独特的养分持久释放

$K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$ 硫酸钾钙镁的化学式



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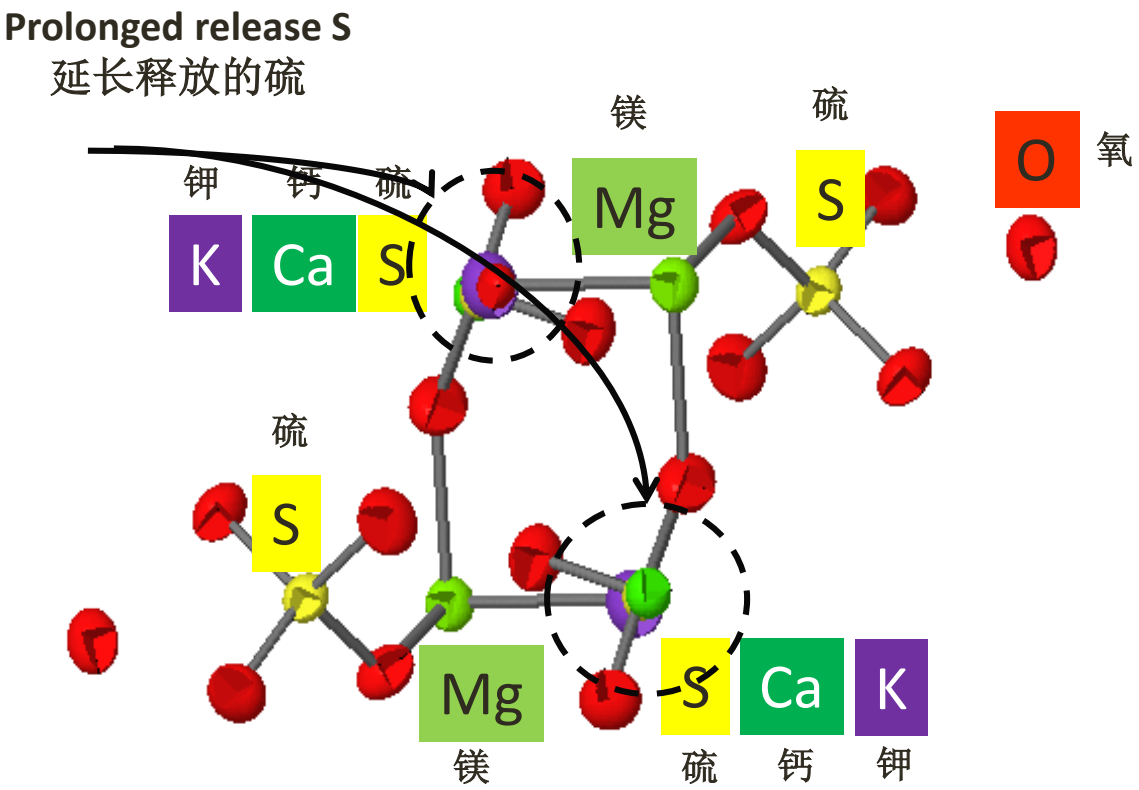
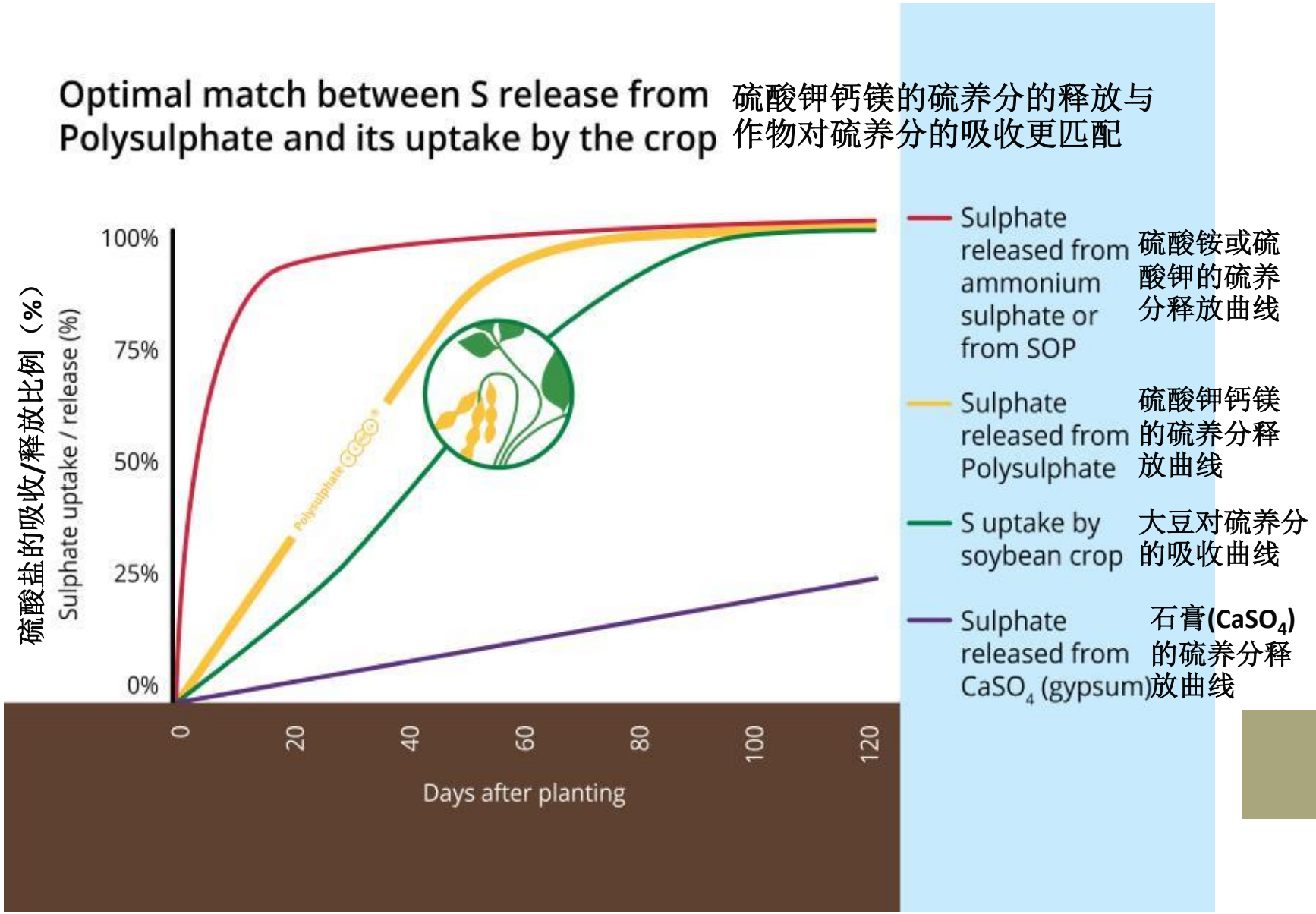
长效性—独特的养分持久释放

$K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$ 硫酸钾钙镁的化学式

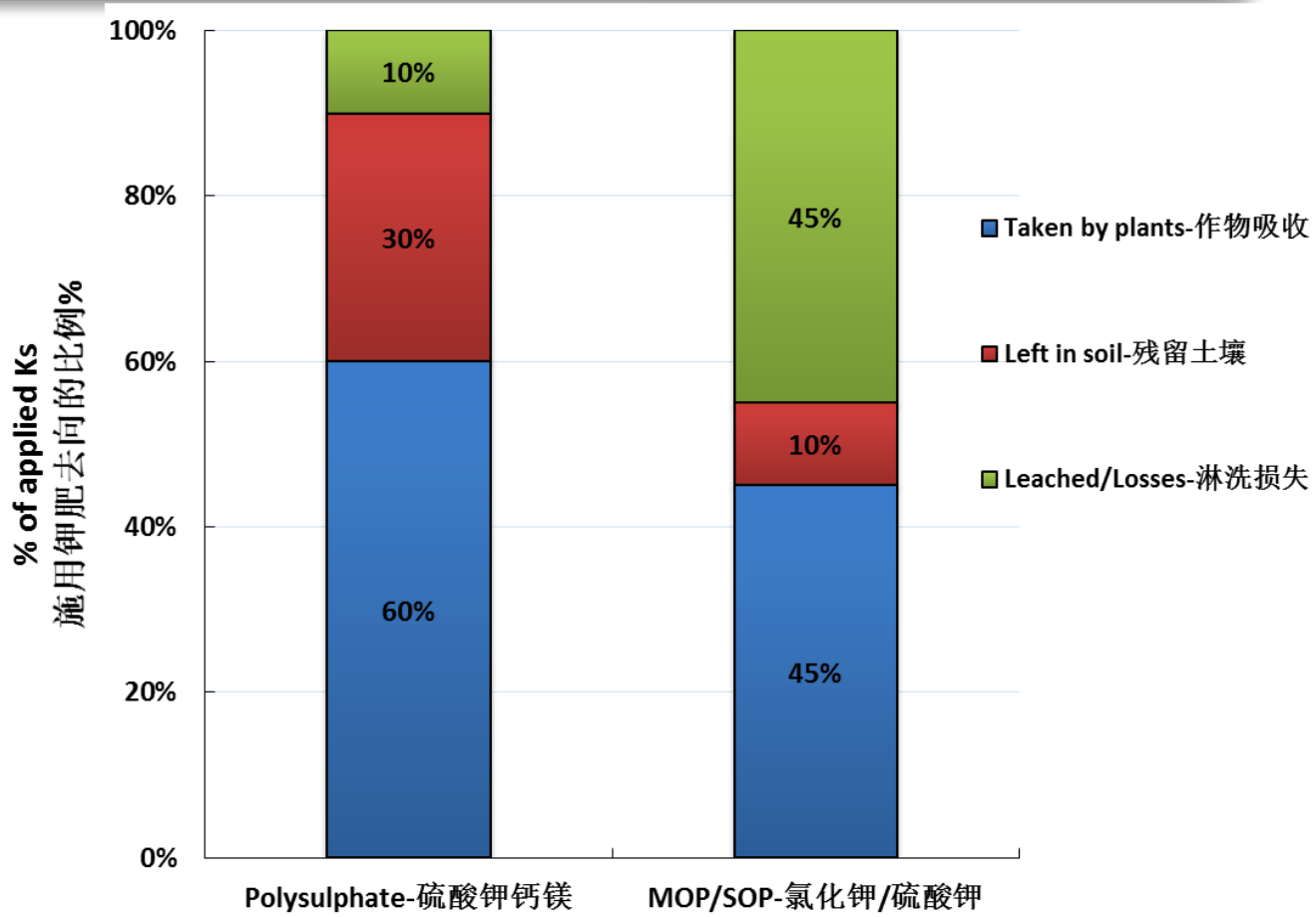


http://publcif.iucr.org/cifmoldb/gui/cifjmol.php?cifid=wm6074

Release of S from Polysulphate
硫酸钾钙镁中S的释放-大豆的S养分需求曲线



淋洗少—养分当季利用效率高



Conclusion结论:

1. **We see in many experiments that K uptake by plants is greater in Poly;施用硫酸钾钙镁后促进作物对钾的吸收;**
2. **The K leached/losses is greater in MOP/SOP;施用氯化钾/硫酸钾后钾肥的淋洗损失量更大;**
3. **This leads to more "left in soil" K, or higher "residual effect". 施用硫酸钾钙镁后钾肥残效更显著.**

盐度低—适用于盐渍化的土壤

Material and analysis /材料和分析	Salt index (*) /盐指数
KCl	116.2
KNO_3	69.5
K_2SO_4	42.6
$MgSO_4$	44
Polysulphate	12

- Per equal weight of material/同等重量的材料

Source: ICL/TAMI report, 5/2015

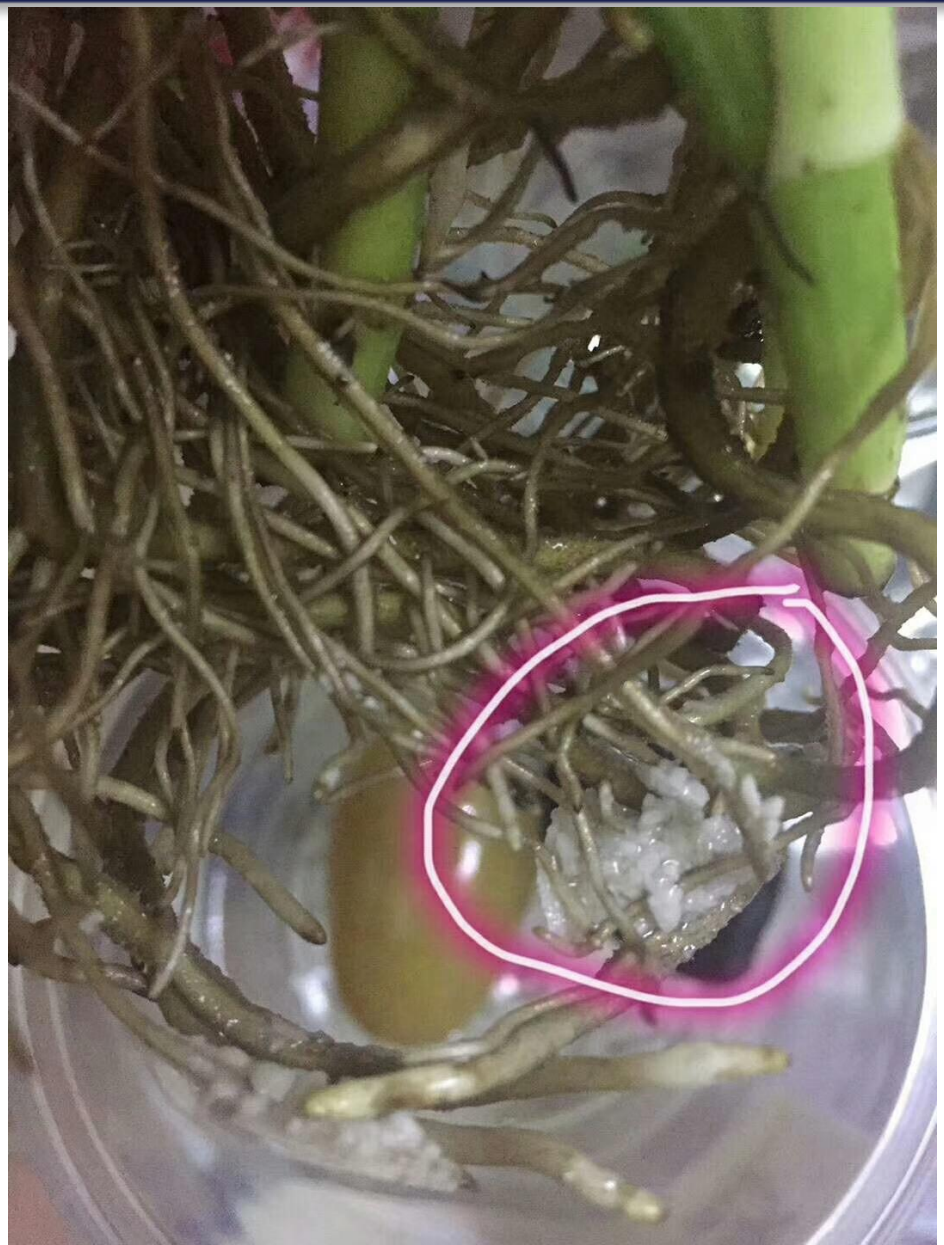
1. Salt index is an important characteristic of a fertilizer /盐指数是一种肥料重要的特性.

2. Salt index is a measure of the salt concentration that fertilizer induces in the soil solution /盐指数是衡量土壤溶液中肥料产生的盐浓度的指标.

3. The higher the osmotic potential of a solution - the more difficult it is for seeds or plants to extract soil water required for growth /溶液的渗透势越高，种子或者作物越难吸收土壤水分.

硫酸钾钙镁的盐度指数极低，连续多年大量使用不会造成土壤盐害的发生，能减少盐害对作物产量的影响。

盐度低—适用于盐渍化的土壤



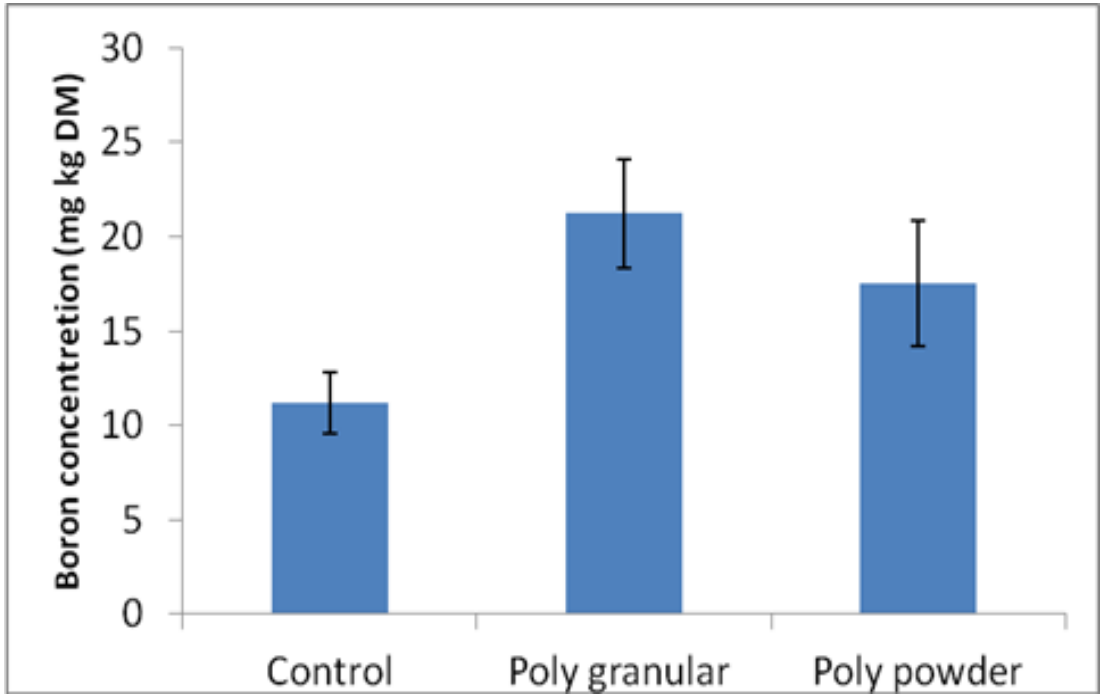
硫酸钾钙镁对作物根系安全性测试

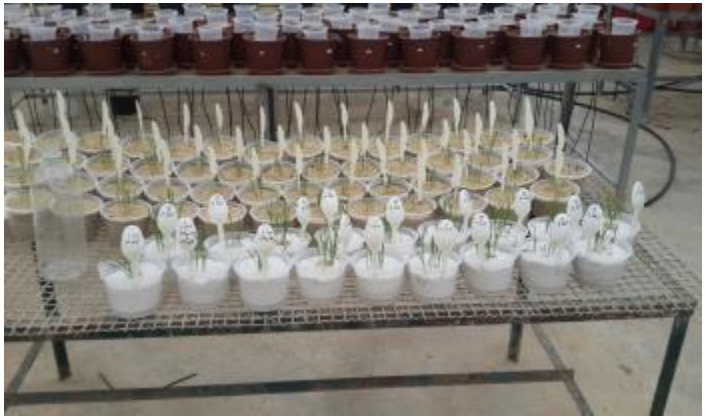
添加硫酸钾钙镁后三天根系生长旺盛.

含有硼—微量元素同补更高效

B level in Polysulphate is ~200-600 ppm 硫酸钾钙镁肥中硼的含量约为200-600 ppm

Boron concentration in wheat DM grown on perlite pots with 2.5 t/ha Polysulphate (2016)
小麦沙培试验中施用2.5 t/ha的硫酸钾钙镁肥后，小麦干物质中硼的浓度





Wheat – Israel – Boron
小麦-以色列-硼

Ideal natural source of nutrients for all crops
适用于各种作物的理想的天然养分来源

适用作物类型

- For Ca/Mg demanding crops/需钙/镁的作物
  Potato, Citrus, Grapes and root vegetables (carrot, parsnips), strawberry for best quality土豆、柑橘、葡萄、块茎类蔬菜、草莓、香蕉等；
- For chloride sensitive crops/氯敏感作物
  tea, tobacco, greenhouse crops茶树、烟草、温室大棚作物；
- For oil crops/油料作物
  sunflower, canola (rape seed),oil palm -where S is essential for oil formation向日葵、油菜、油棕、硫是形成油脂的必需元素；
- For pastures and forage crops/牧草作物
  to prevent magnesium deficiency in ruminant animals预防反刍动物的镁营养缺乏；
- For N-fixing leguminous crops固氮的豆科作物
  which need high S for nodule formation
  根瘤的行程需要大量的硫
- For organic crops/有机种植作物

适用土壤和气候类型

- For sandy soil in high rainfall areas强降雨地区的砂质土壤
  South of China中国南方的大部分区域；
- For acid soil酸性土壤
  Red soil and laterite soil红壤和砖红壤；
- For salinity soil盐渍化土壤
- For S deficient soil缺S土壤

Agronomic research on Polysulphate in China
硫酸钾钙镁在中国的农学研究

Tomato and leaf vegetables for Poly registration-小白菜、西红柿、花生、大姜

Potato-马铃薯

K experiment on maize 玉米

玉米、大豆、水稻

Maize 玉米

Poly demonstration on strawberry, rapeseed, peanut and broccoli-油菜、花生、草莓、西兰花

Peanut, Potato, Grape, Strawberry, Tomato, Cucumber

Ggrapes, Tomato, Broccoli, Watermelon

Kiwi Fruit, Grapes, Citrus, Mango
猕猴桃、葡萄、柑橘、芒果

Poly experiment on tea-茶叶

Poly experiment on banana (IPI)-香蕉

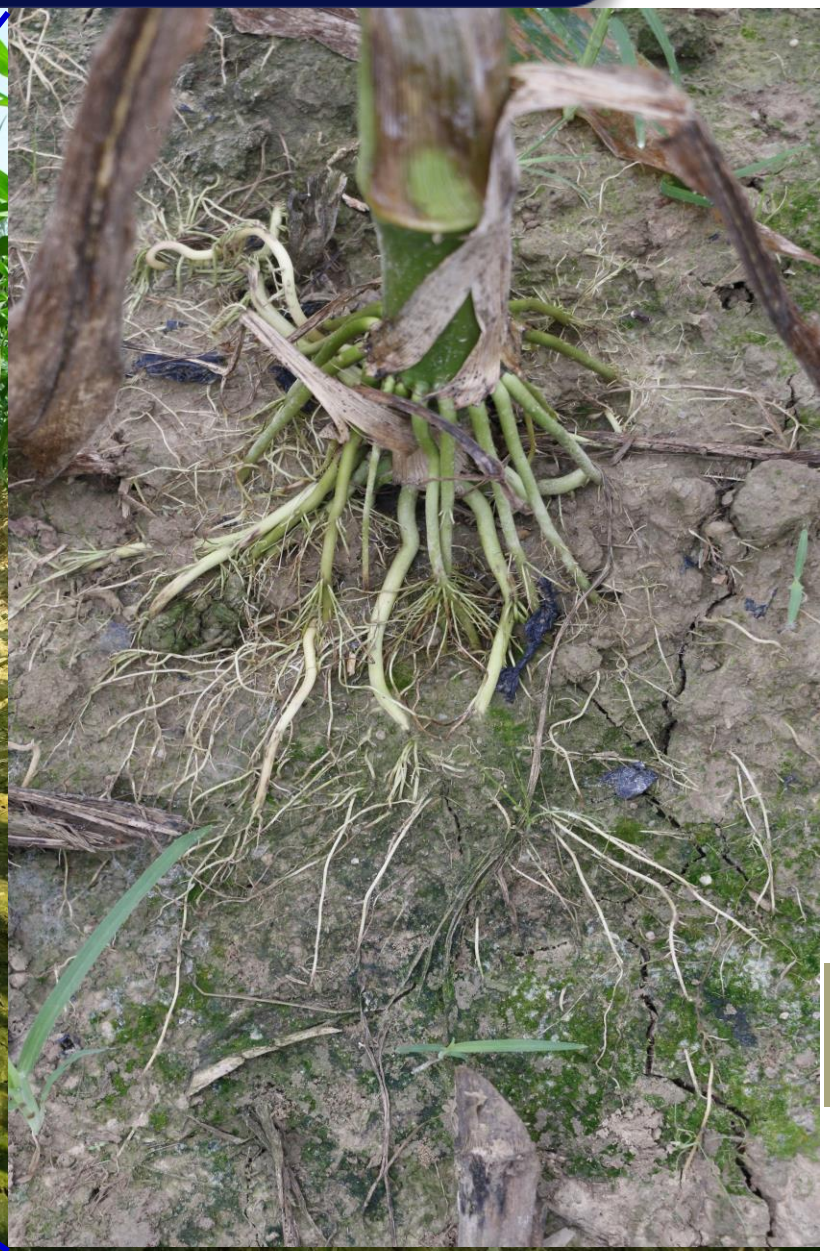
Tobacco, Vegetables, Fruit
烟草，叶菜，水果

Poly demonstration on Pomelo-柚子

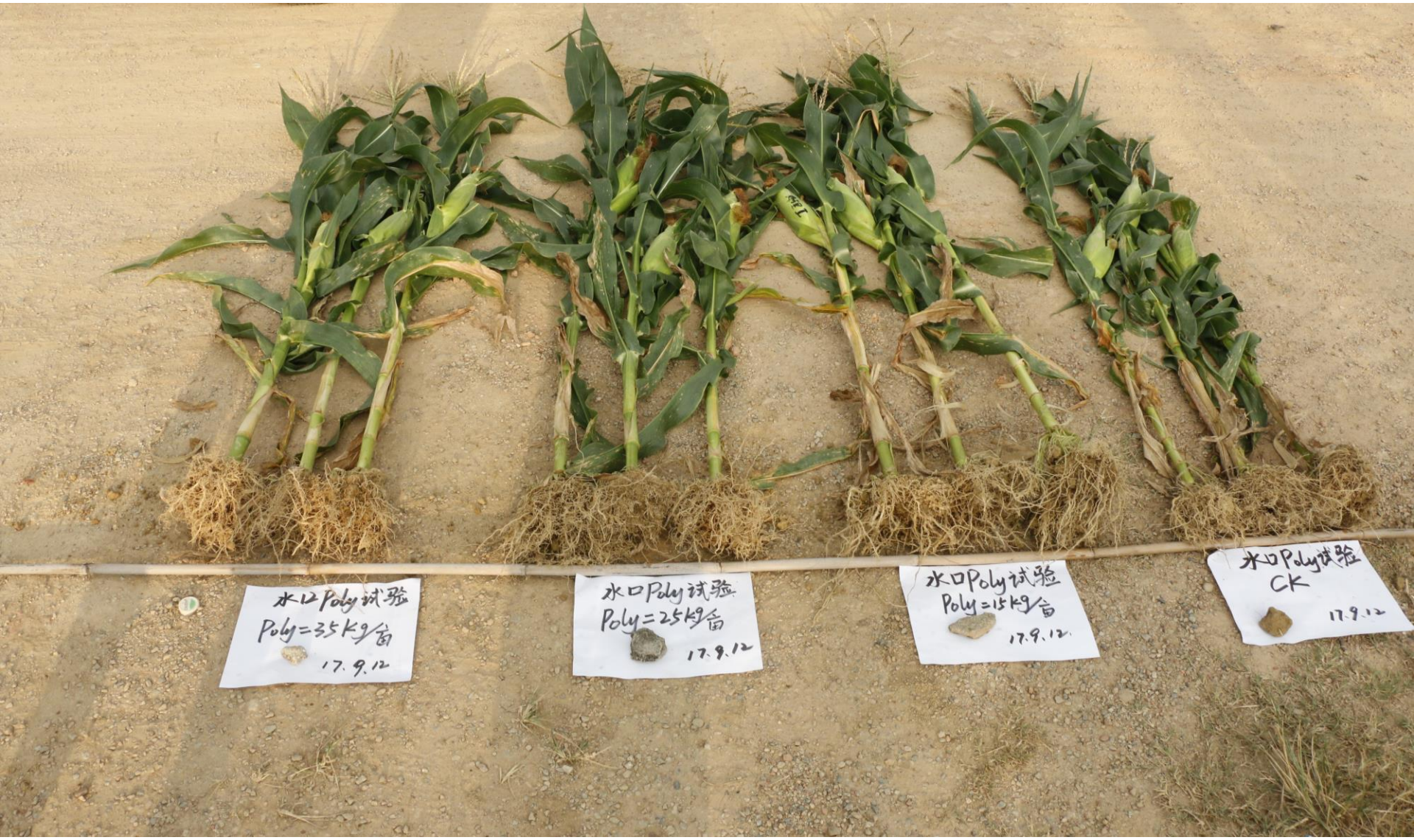
Chinese Cabbage, Fruits and pepper-大白菜、辣椒、水果、蔬菜

Poly demonstration on Maize, Banana, Citrus and Chinese yam-玉米、香蕉、红橙、山药

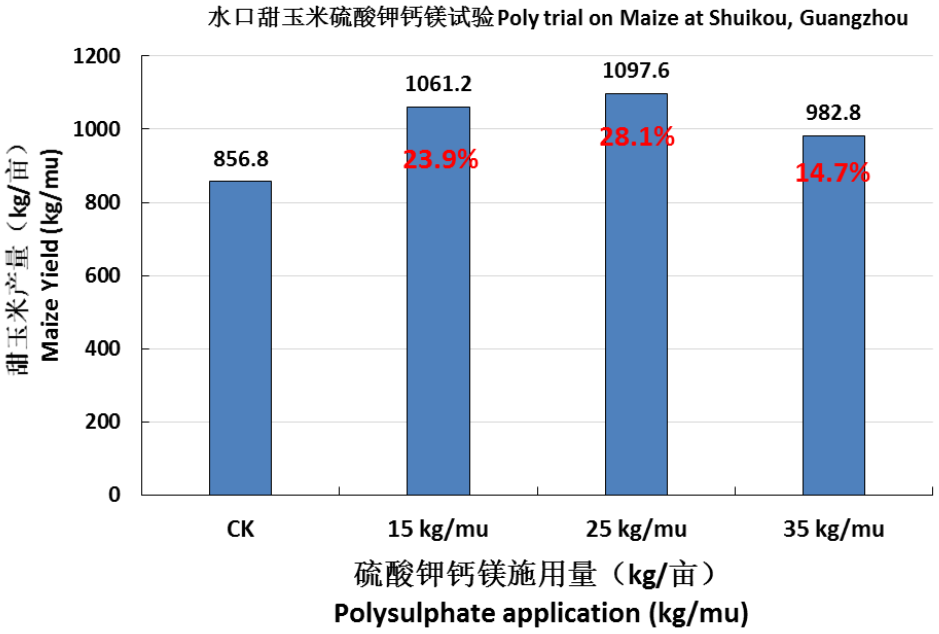
广州甜玉米试验

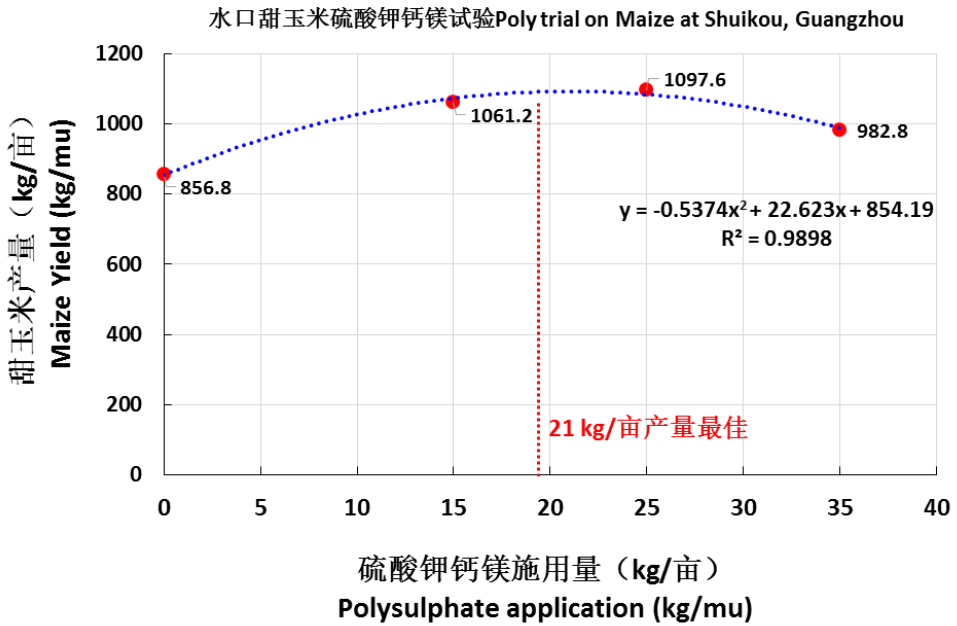


广州甜玉米试验


水口Poly试验
Poly=35kg/亩
17.9.12
水口Poly试验
Poly=25kg/亩
17.9.12
水口Poly试验
Poly=15kg/亩
17.9.12
水口Poly试验
CK
17.9.12

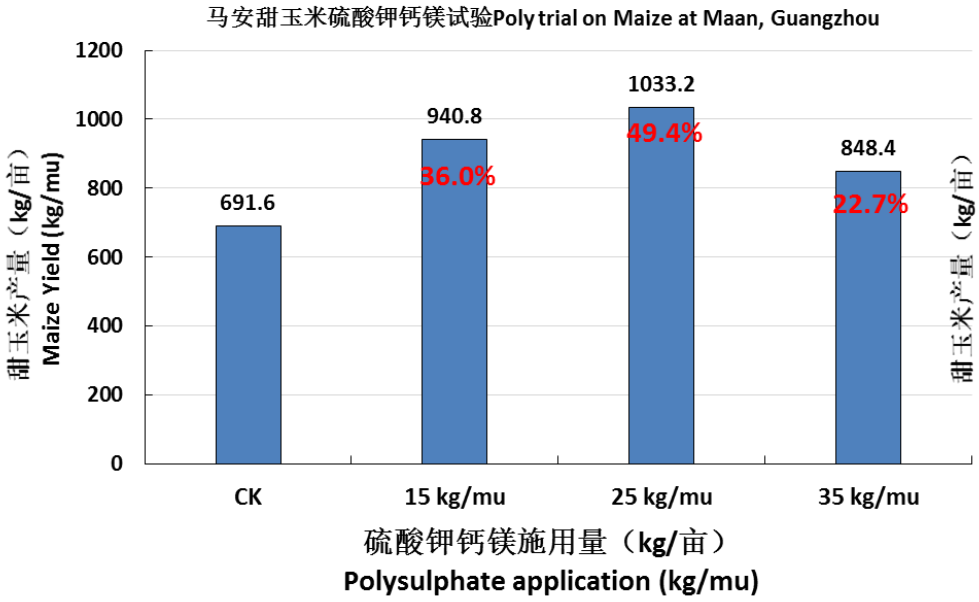
广州甜玉米试验

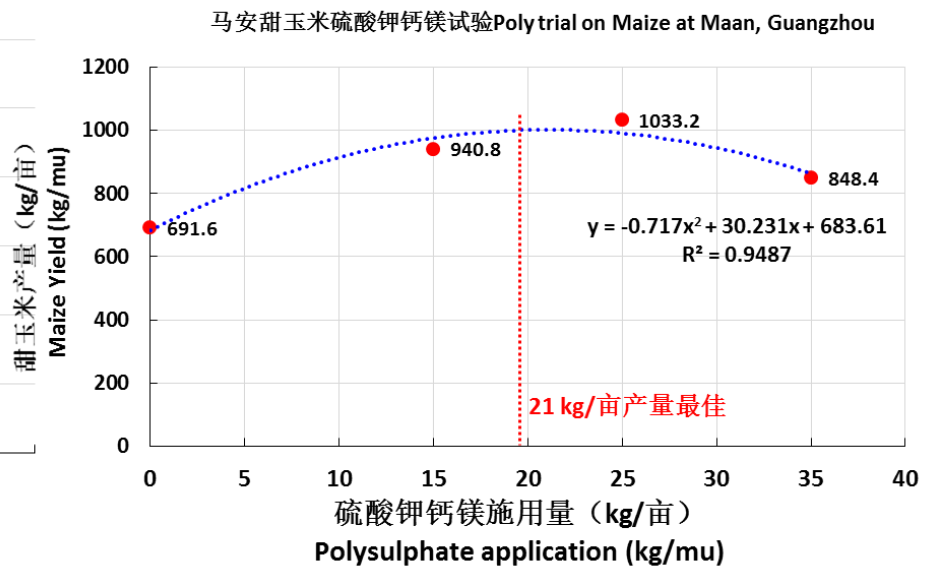




Treatments	Yield increased (kg/mu)	Income increased (RMB/mu)	Net income (RMB/mu)
15 kg/mu Poly	204.4	490	430
25 kg/mu Poly	240.8	578	478
35 kg/mu Poly	126.0	302	162

广州甜玉米试验





Treatments	Yield increased (kg/mu)	Income increased (RMB/mu)	Net income (RMB/mu)
15 kg/mu Poly	249	598	538
25 kg/mu Poly	342	821	721
35 kg/mu Poly	157	377	237

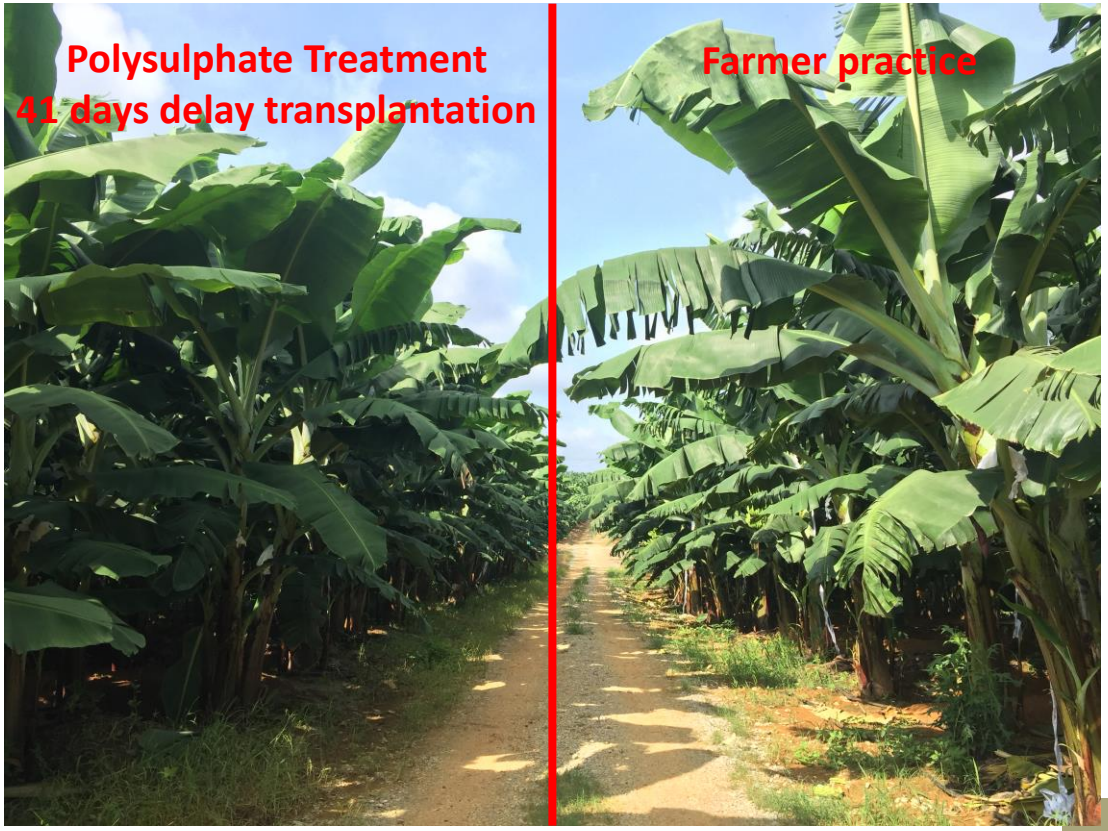
For field crops in China, Polysulphate is recommended at 25-30 kg/mu.

内蒙古马铃薯示范试验

底肥施用大颗粒硫酸钾钙镁: 50 kg/亩，替代15 kg/亩的硫酸钾，马铃薯亩产增加 7.4%

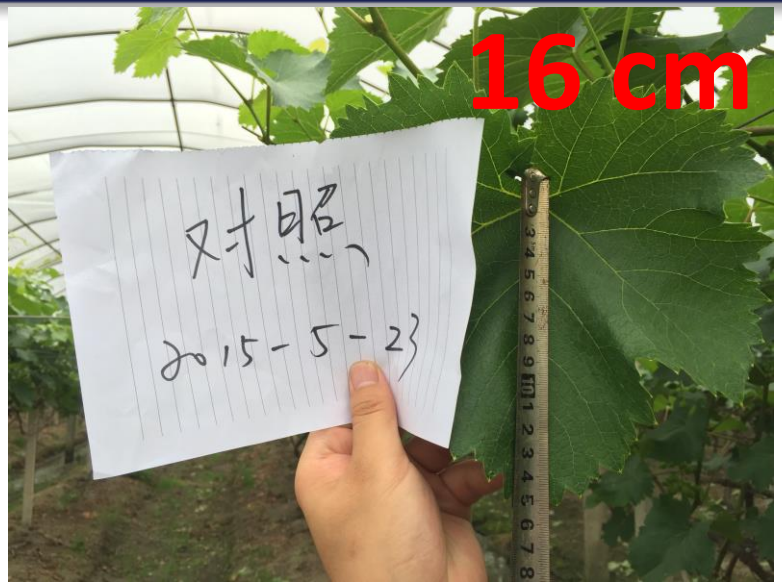
广西香蕉试验

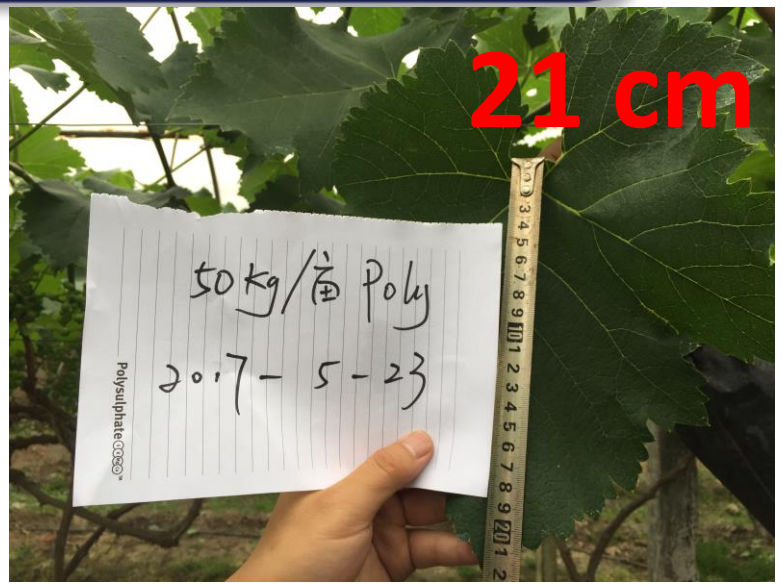
Polysulphate Treatment

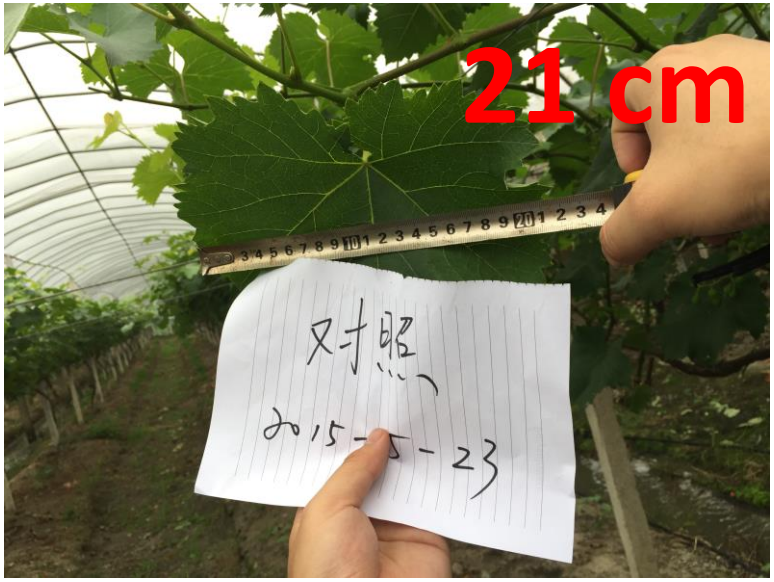


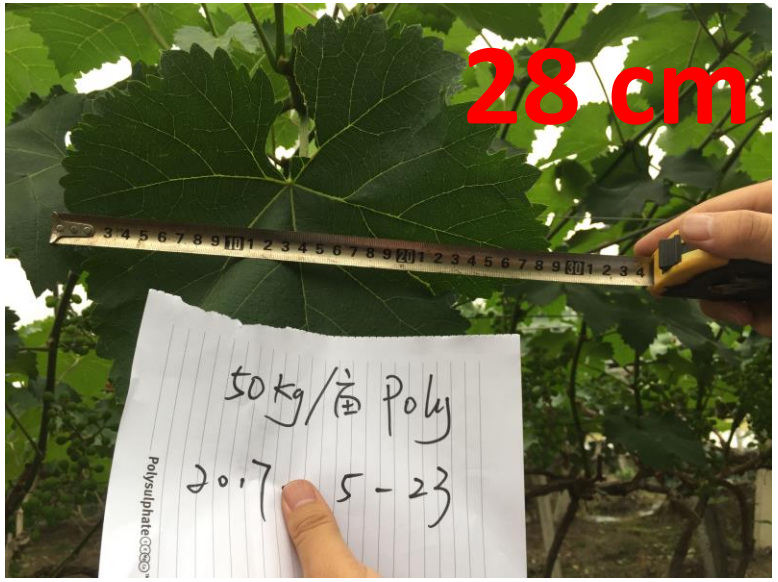
广西香蕉试验

浙江葡萄试验


16 cm
对照
2015-5-23


21 cm
50kg/亩 Poly
2017-5-23


21 cm
对照
2015-5-23


28 cm
50kg/亩 Poly
2017-5-23

浙江葡萄试验

亩用硫酸钾钙镁50kg，开沟施用；

对照：农户传统处理；

葡萄谢花1-2天，农户表示施用50kg硫酸钾钙镁的葡萄花穗大、花穗多

浙江葡萄试验

亩用硫酸钾钙镁50kg，开沟施用；

对照：农户传统处理；

谢花后12-15天，葡萄刚进入膨大期，施用50kg硫酸钾钙镁的葡萄坐果率明显高于对照，膨大速度快

浙江葡萄试验

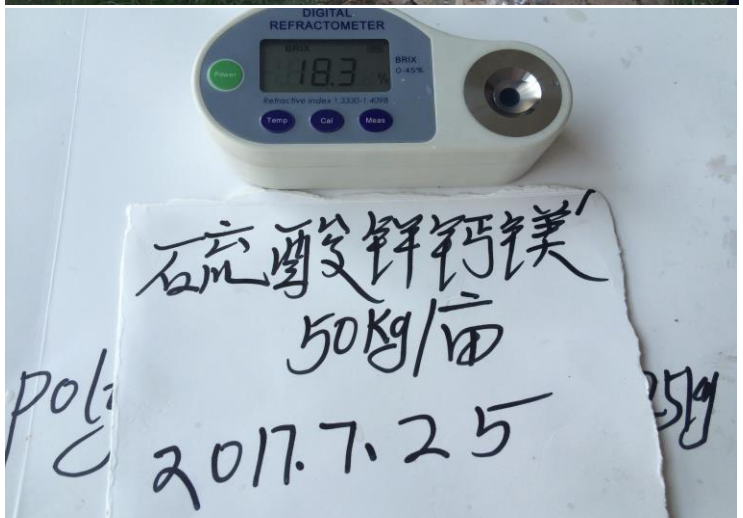
亩用硫酸钾钙镁50kg，开沟施用；

对照：农户传统处理；

葡萄转色期，施用50kg硫酸钾钙镁的葡萄转色最早

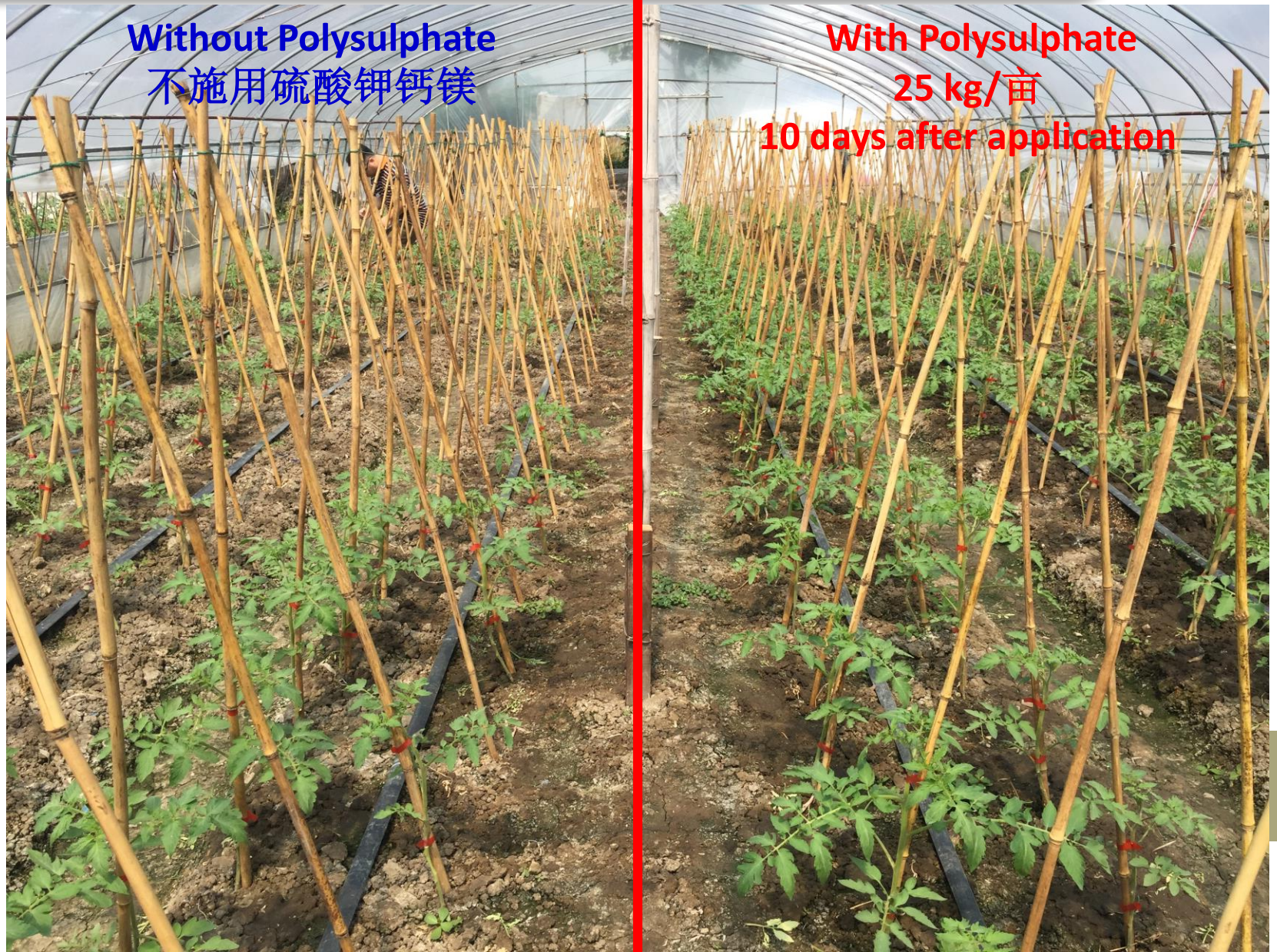
浙江葡萄试验

亩用硫酸钾钙镁50kg，开沟施用；



对照：农户传统处理；

浙江西红柿试验


Without Polysulphate
不施用硫酸钾钙镁
With Polysulphate
25 kg/亩
10 days after application

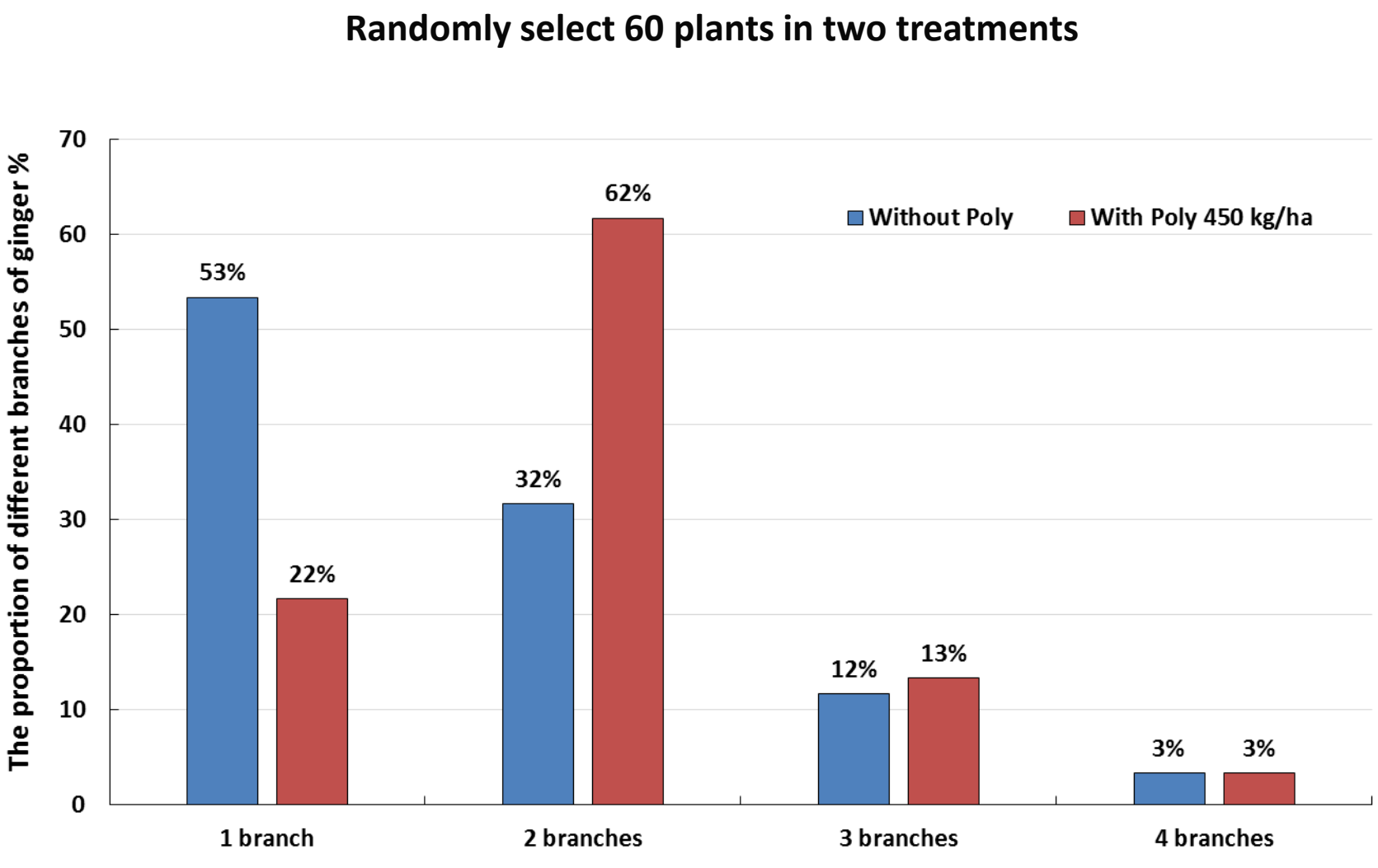
山东樱桃试验

山东大姜试验


Without Poly

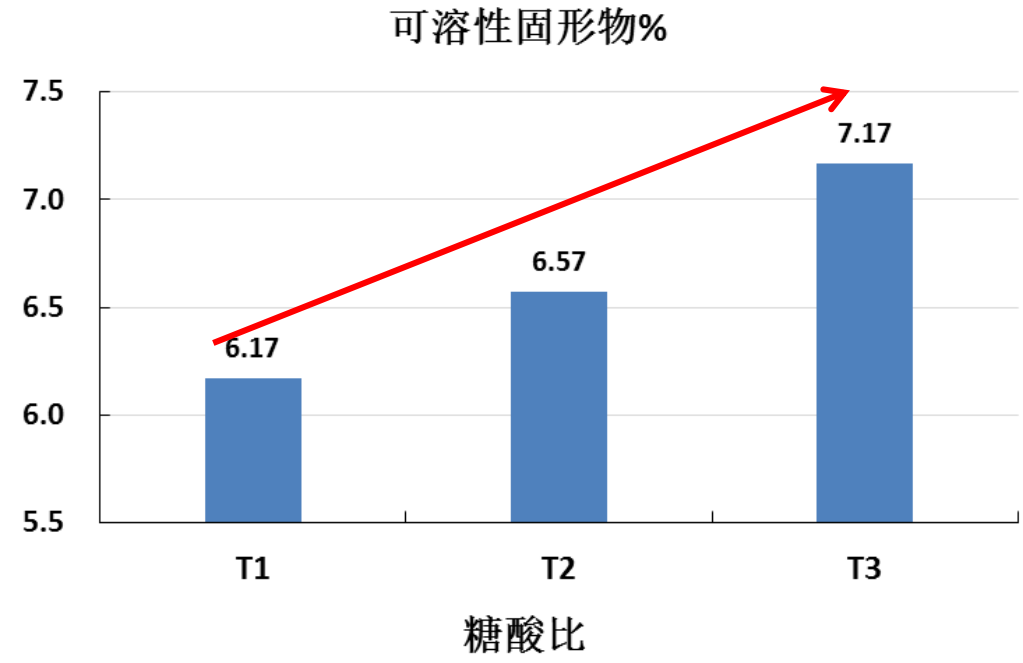

With Poly 30 kg/亩
Applied Poly at 15th March
450 kg/ha

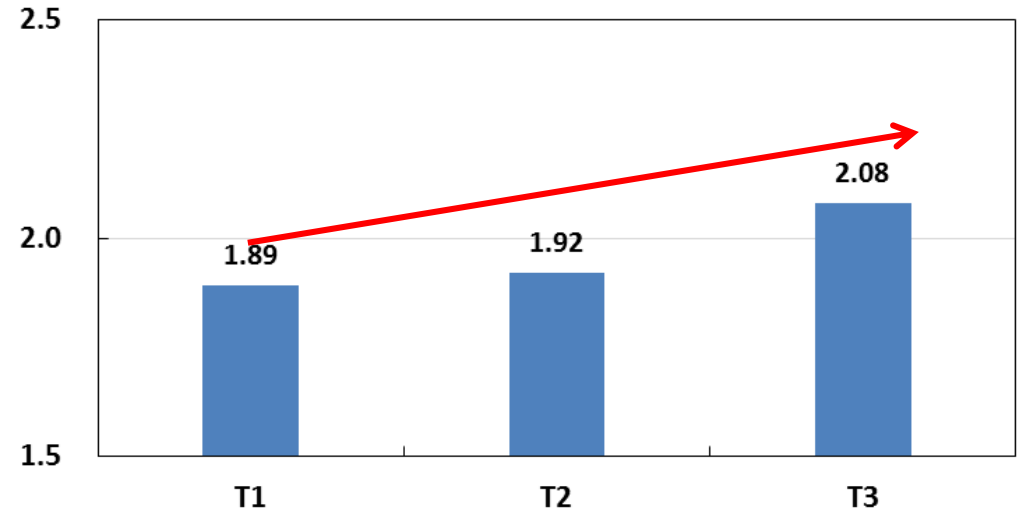
山东大姜试验


Randomly select 60 plants in two treatments
The proportion of different branches of ginger %
70
60
50
40
30
20
10
0
Without Poly
With Poly 450 kg/ha
53%
22%
32%
62%
12%
13%
3%
3%
1 branch
2 branches
3 branches
4 branches

湖北草莓试验

湖北草莓试验





T2、T3比对照可溶性固形物分别提高0.4%、1.0%； T3处理糖酸比最大。

同时，硫酸钾镁肥处理T2、T3比T1（CK）分别增产3.50%和6.50%。

云南叶菜试验

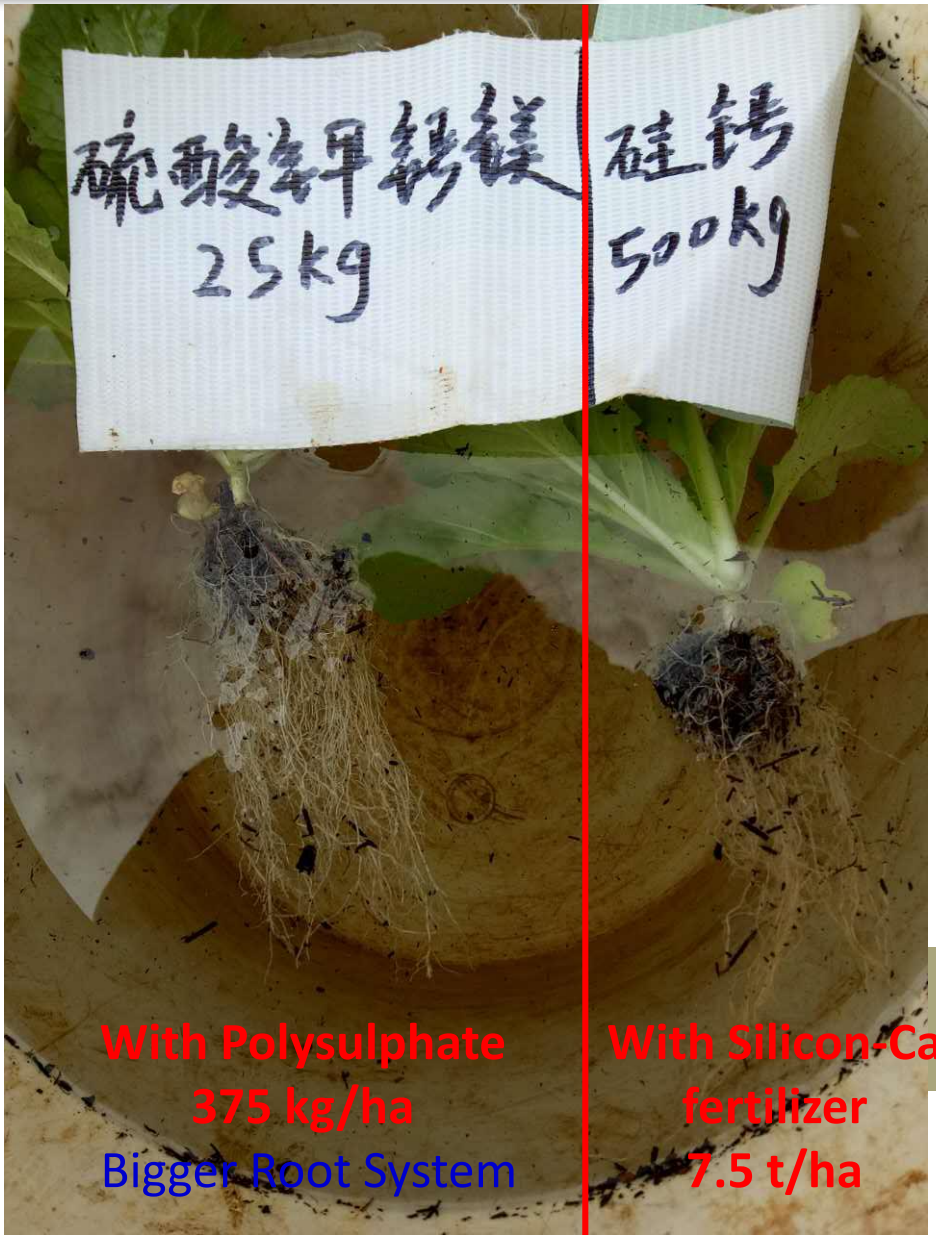

Without Polysulphate
硫酸钾钙镁 对照区
2017-09-25


With Polysulphate
375 kg/ha
High emergence rate
硫酸钾钙镁 实验区
2017-09-25

云南叶菜试验

With Polysulphate
375 kg/ha
Bigger Root System

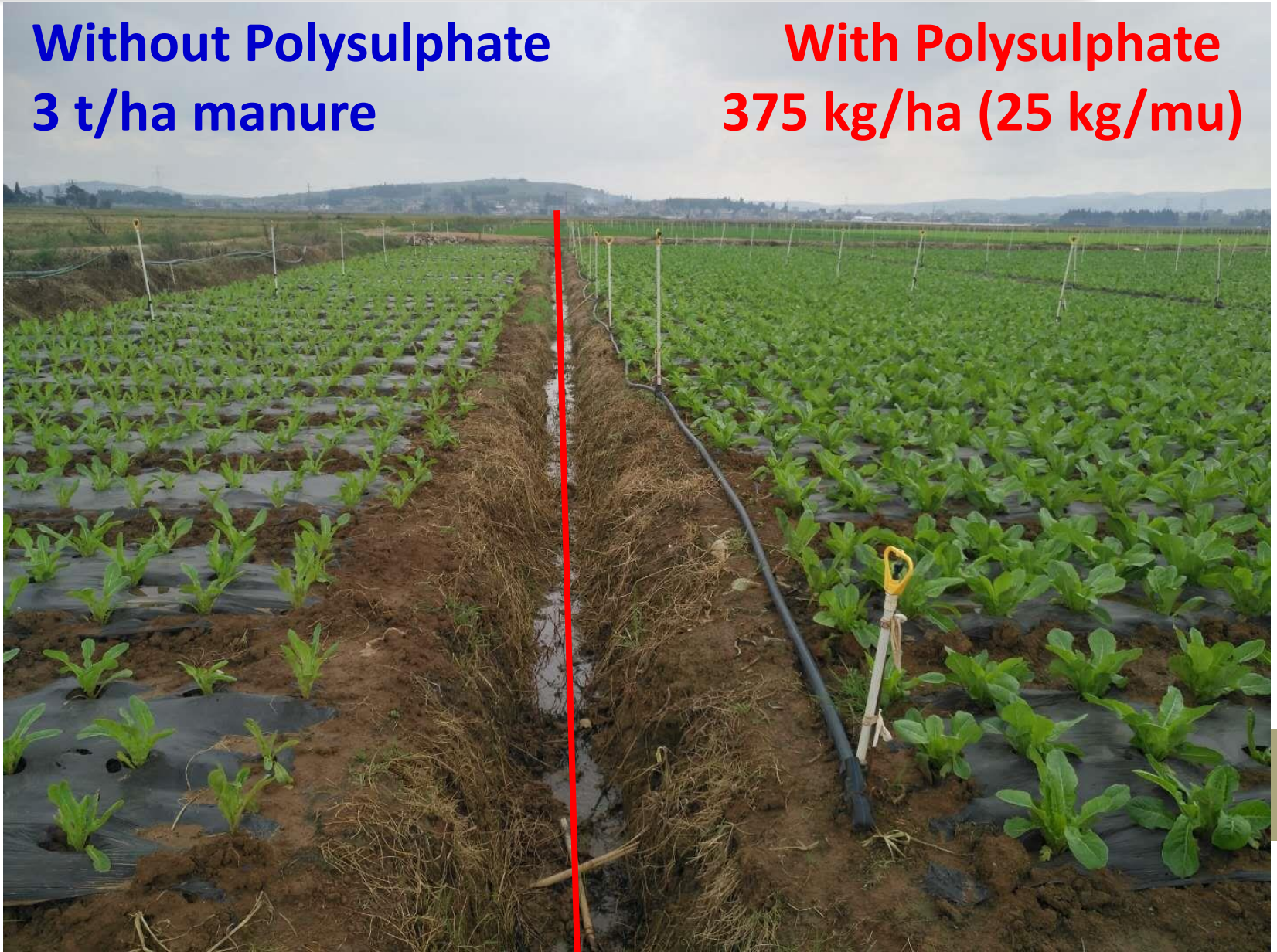
With Silicon-Ca
fertilizer
7.5 t/ha



With Polysulphate
375 kg/ha
Bigger Root System

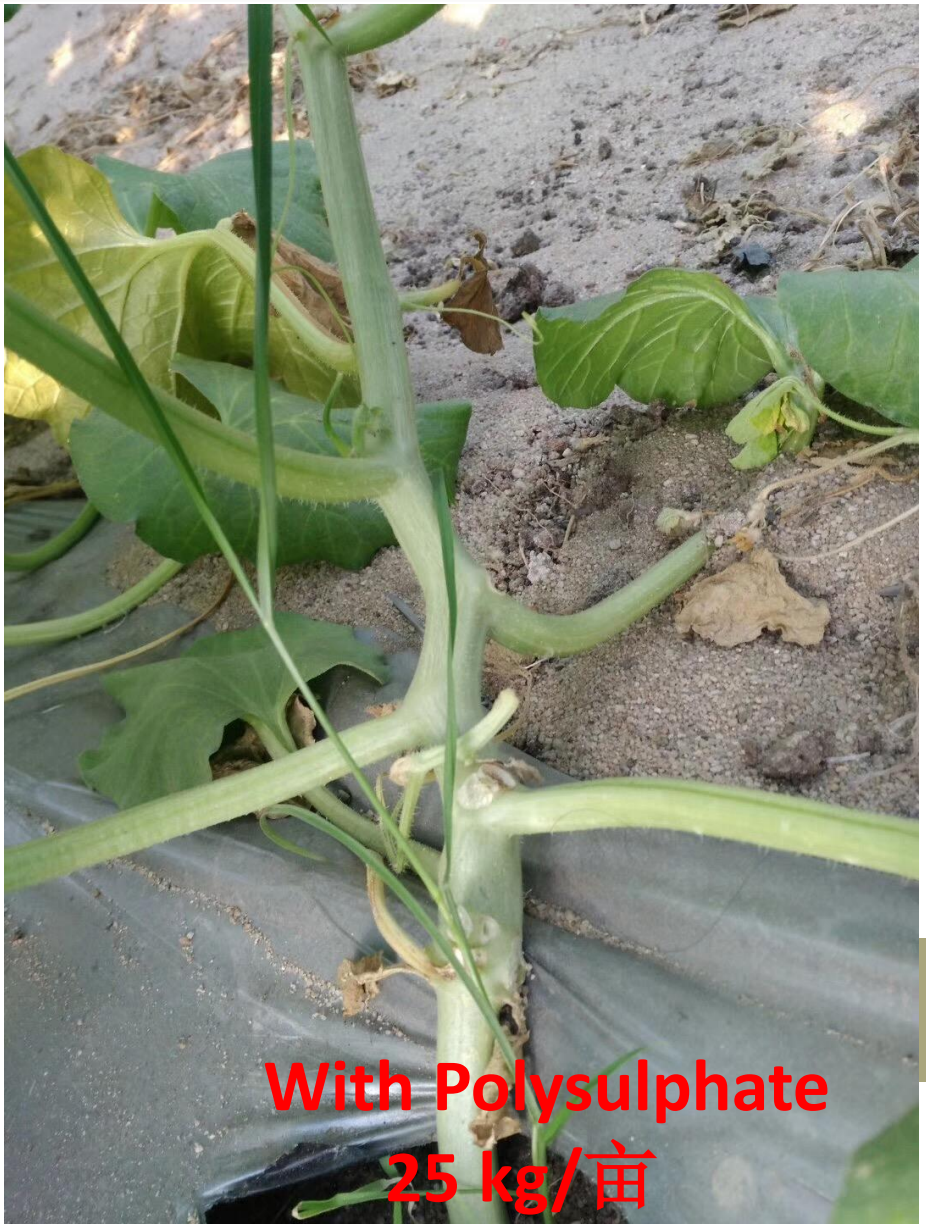
With Silicon-Ca
fertilizer
7.5 t/ha

云南叶菜试验

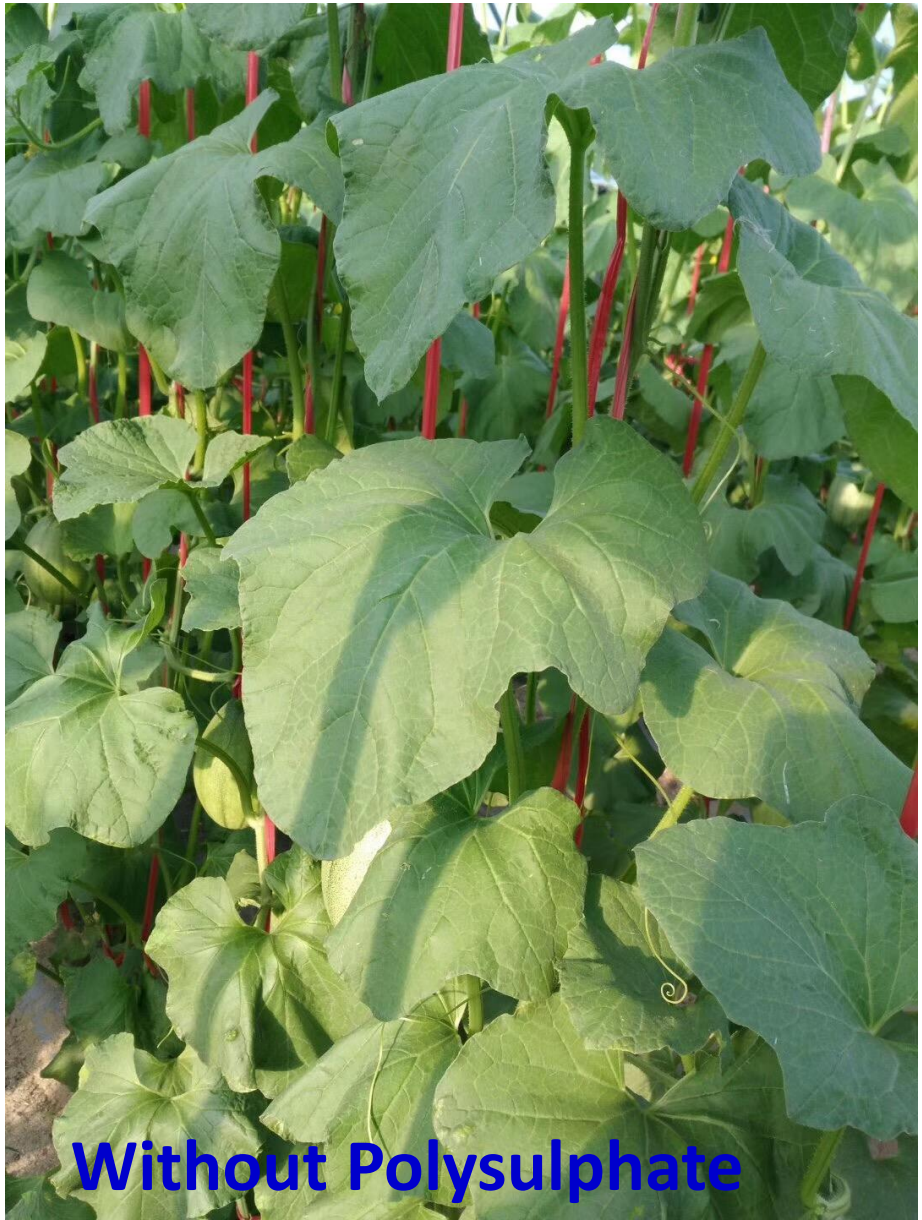

Without Polysulphate
3 t/ha manure
With Polysulphate
375 kg/ha (25 kg/mu)

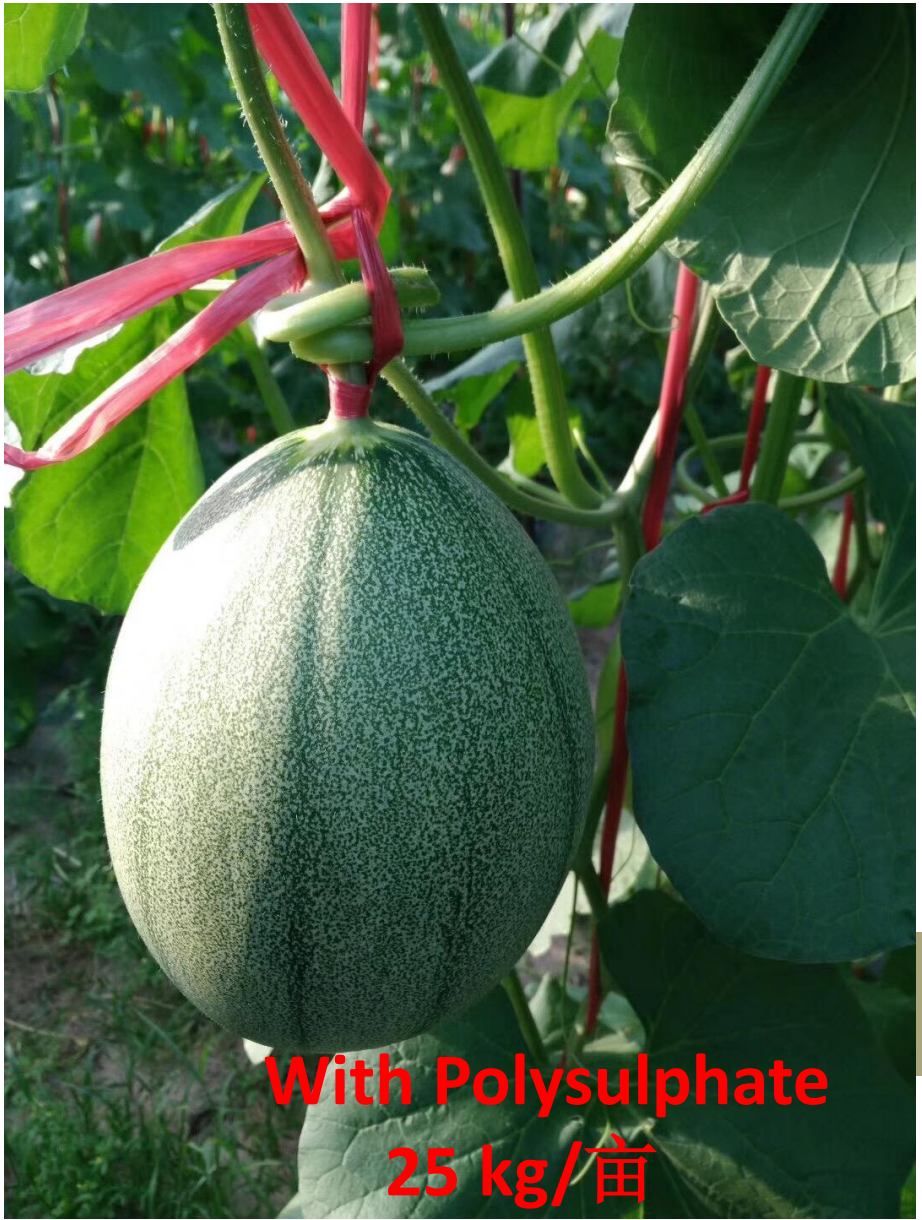
云南叶菜试验

海南哈密瓜试验



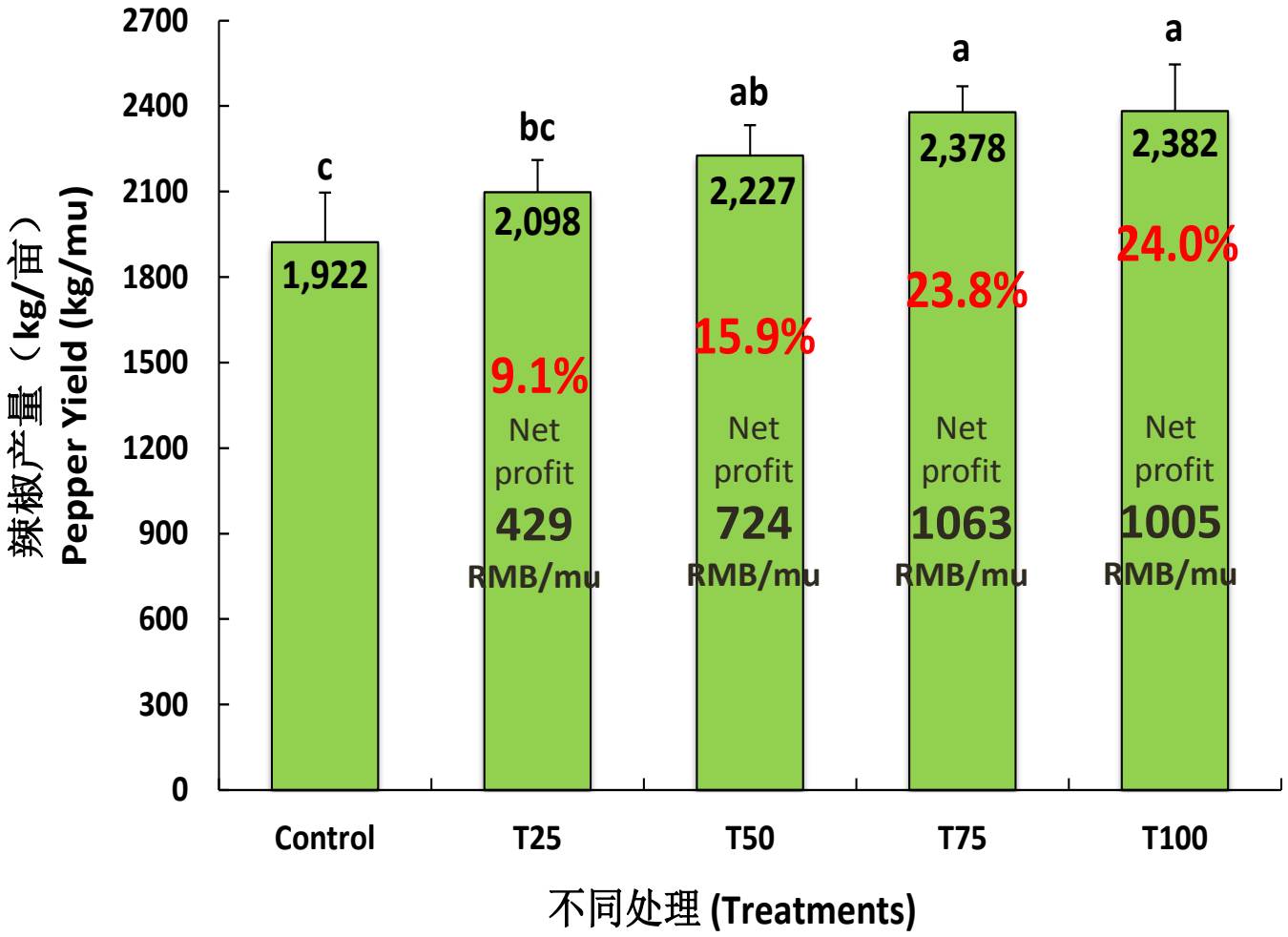
海南哈密瓜试验





海南辣椒试验

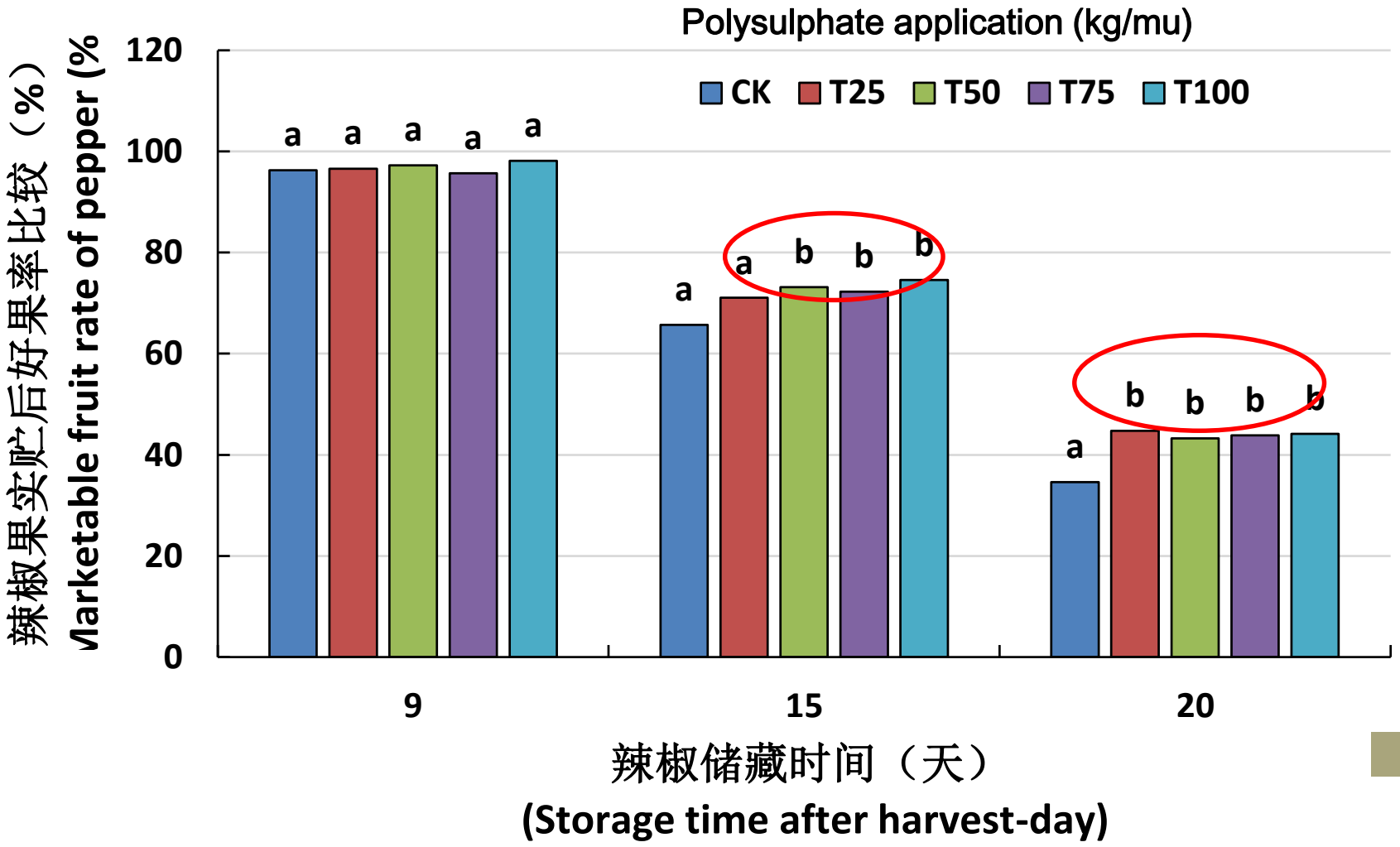
Effectiveness of Polysulphate on pepper yield, 2016
/2016年施用硫酸钾钙镁对海南辣椒产量的影响



Polysulphate application (kg/mu) 硫酸钾钙镁施用量 (公斤/亩)　Control = FP (农民施肥习惯)

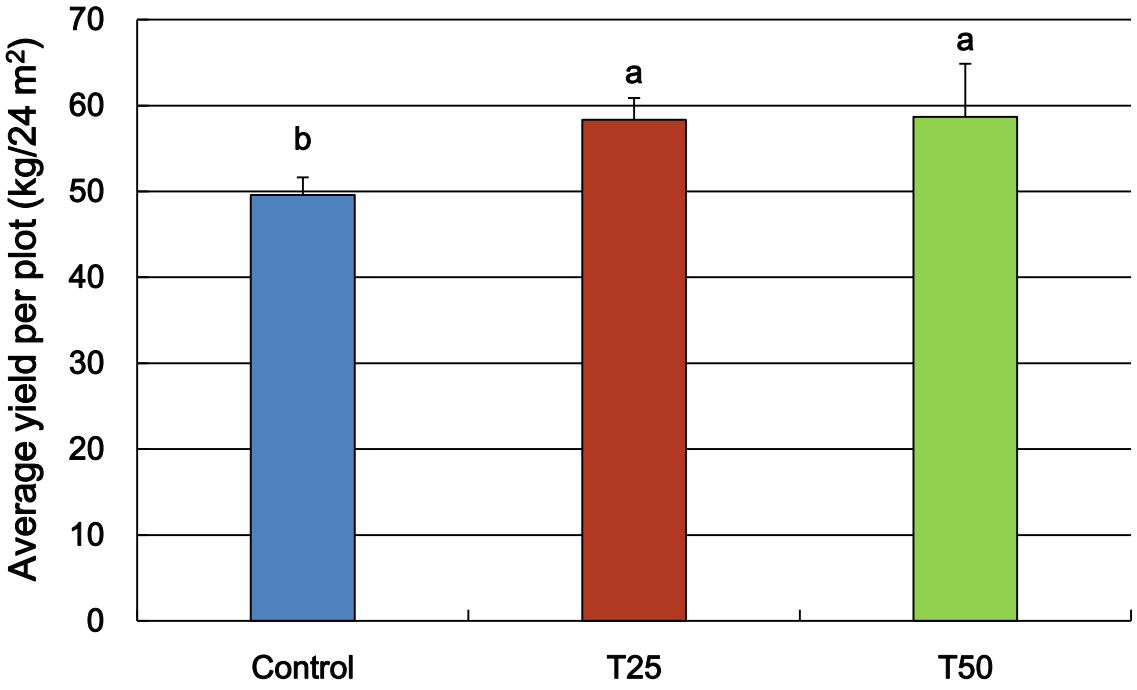
海南辣椒试验

Effectiveness of Polysulphate on pepper storage time, 2016
/2016年施用硫酸钾钙镁肥对海南辣椒储藏时间的影响



海南大白菜试验

Effectiveness of Polysulphate on Chinese cabbage yield, 2015
/2015年施用硫酸钾钙镁肥对大白菜产量的影响



Control: Conventional fertilizing (常规施肥)

T25: Conventional fertilizing + 25 kg/mu Poly (常规施肥+25公斤硫酸钾钙镁肥/亩)

T50: Conventional fertilizing + 50 kg/mu Poly (常规施肥+50公斤硫酸钾钙镁肥/亩)

What can we learn? /我们可得到的结果？

Application of polysulphate significantly increased Chinese cabbage yield.
/硫酸钾钙镁肥的施用能显著提高大白菜的产量.

No significant difference in grain yield was found between different Poly treatments.
/不同的硫酸钾钙镁肥施用量对大白菜产量没有显著影响.

黑龙江大豆试验

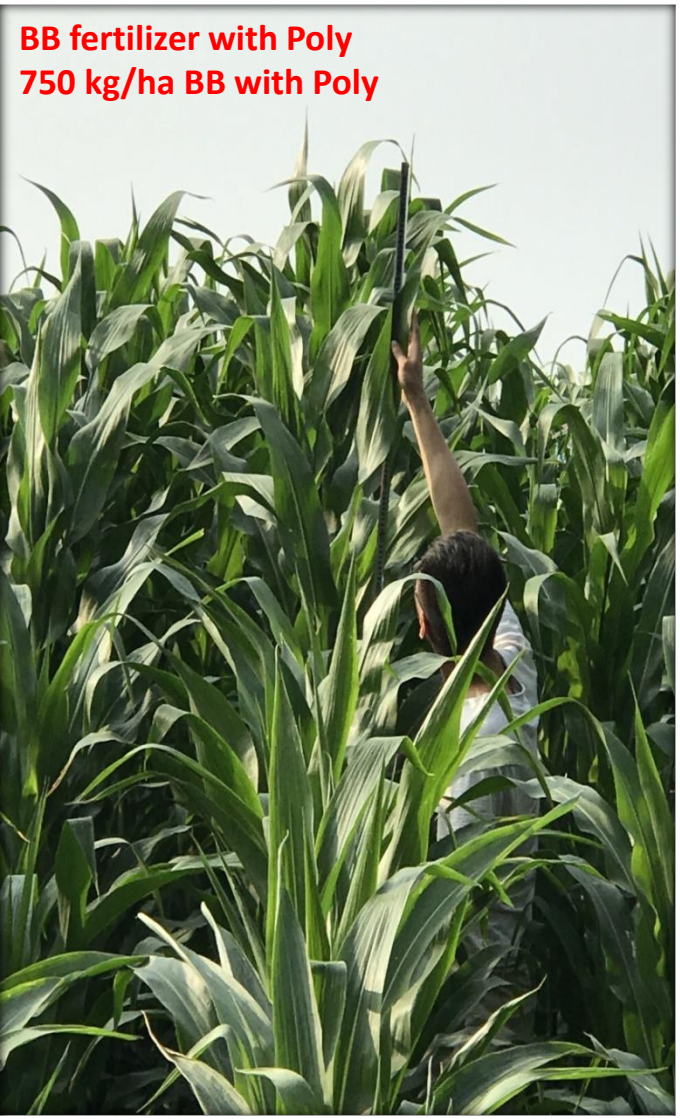

BB fertilizer with Poly
300 kg/ha BB with Poly
示范组
叶片增厚
长势喜人

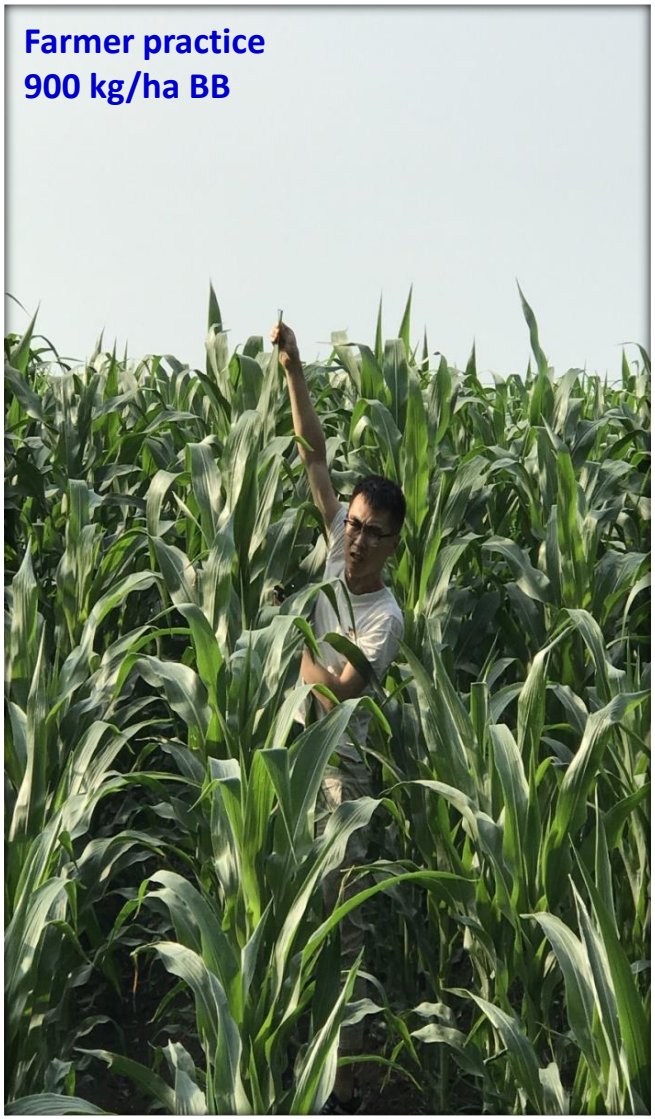

Farmer practice
300 kg/ha BB
对照组
叶片发黄

黑龙江水稻试验


BB fertiliz
37.5 kg/亩
ice
BB fertilizer with Poly
563 kg/ha BB with Poly
Farmer practice
600 kg/ha BB

黑龙江玉米试验





Farmer Practice
900 kg/ha 14-24-9
Cost: 2250 RMB/ha

BB fertilizer with Poly
750 kg/ha 12-23-12
Cost: 1950 RMB/ha

黑龙江玉米试验


BB fertilizer with Poly
750 kg/ha BB with Poly


Farmer practice
900 kg/ha BB


以色列
硫酸钾钙镁肥
示范田

硫酸钾钙镁农作物试验总结

Crop	Brazil	Argentina	USA	China	Vietnam	France	UK	Israel	Ireland	Turkey	Holland	Sweden	Italy	India	Colombia	Ecuador
Soybean	+	+	+	+									+			
Maize	+	+	+	+		+					+					
Cotton	+									+						
Tobacco	+			+												
Citrus	+			+												
Sugarcane	+			+											+	
Coffee	+				+											
Oil palm	+															
Rape seed				+		+	+									
Tea				+	+											
Grass / Alfalfa	+				+	+	+		+			+				
Potato	+		+	+		+	+	+			+	+				
Rice				+												
Leafy veg / celery				+				+								
Tomato				+				+								
Banana	+			+												+
Grapes				+		+										
Apple			+	+												
Wheat		+		+		+										
Black Pepper				+	+											
Sunflower						+										
Mango				+												
Carrot Onion	+					+		+		+	+					
Groundnut	+			+				+								
Broccoli				+												
Brassica	+					+	+							+		
Mustard / sesame														+		
Peas beans				+			+									
Ginger				+												
Garlic				+												
Cherry				+												
Strawberry				+												
Chinese Cabbage				+												
Chinese Yam				+												
Fresh cut flowers				+												

Thank you
谢谢