Agronomic Performance of Phosphate Fertilizers Varying in Solubility to Soybean in Oxisol of Brazilian Cerrado

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Tuesday - November 04th, 2014

SSSA Division: Soil Fertility & Plant Nutrition

- Crop response to and soil dynamics of phosphorus and sulfur -

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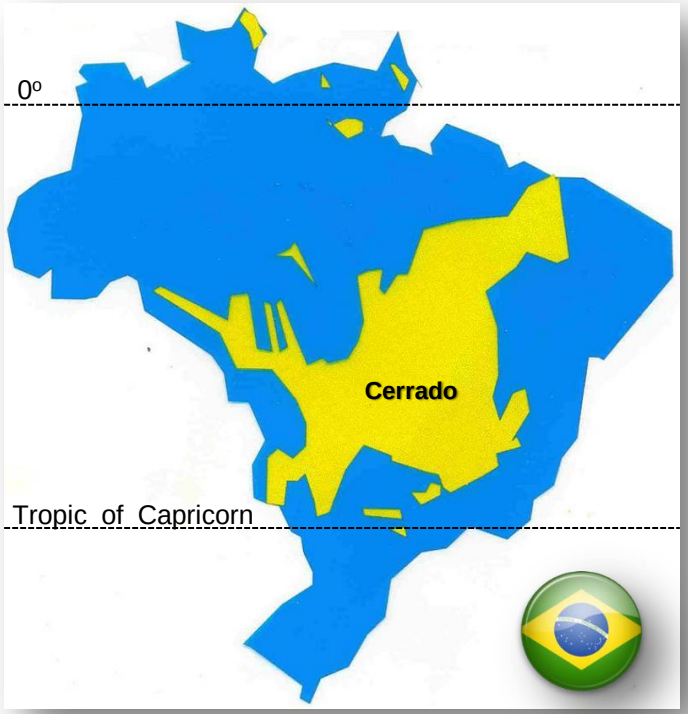
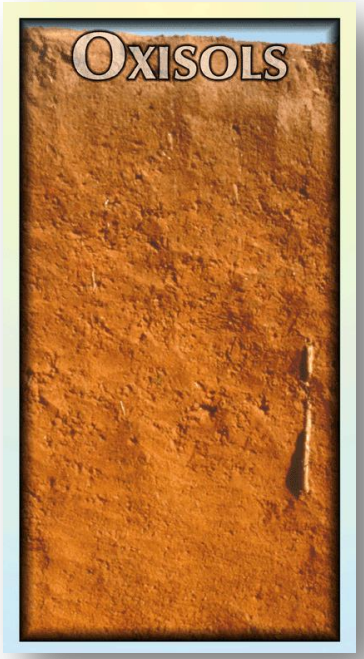
Background

Weathered soils & P management

Acidic Soils ✚ **Generalized nutrient deficiency**





- ✓ Natural low P
- ✓ Fe and Al oxides
- ✓ Specific adsorption
- ✓ Precipitation
- ✓ So on…

Consequence

Itiquira, MT

- P

Background

PR quality & consequences

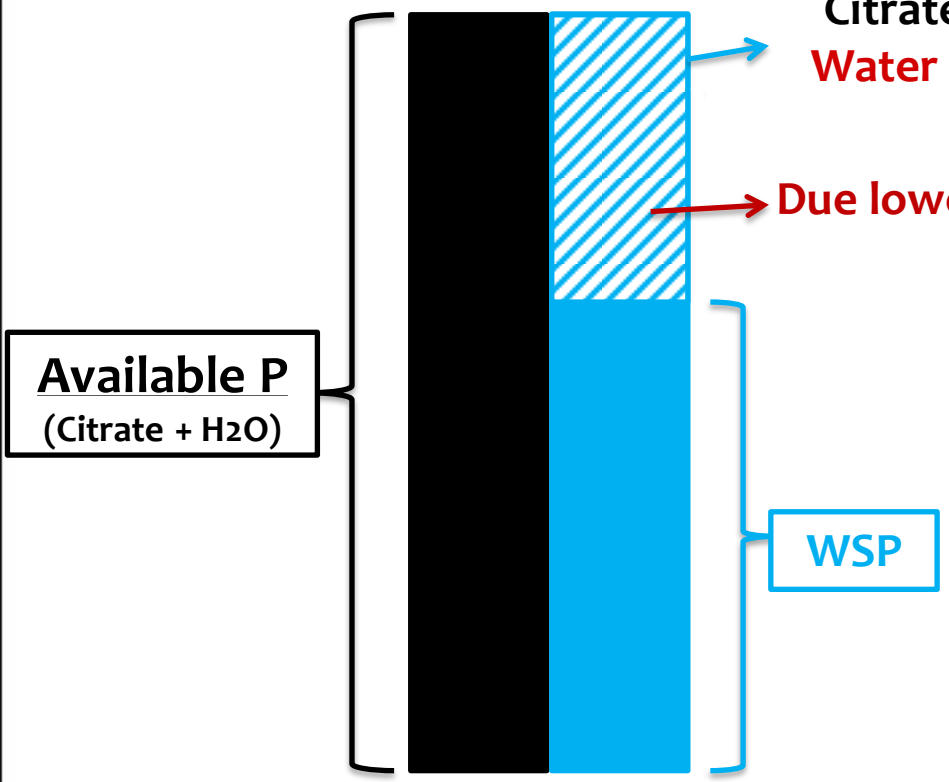
- Most of the *"Premium"* PR has been mined worldwide.
- Therefore, fertilizer industry is forced to use even more lower grade PR.

Consequences

- Beneficiation / concentration
- High levels of impurities
- Water insoluble P in acidulated fertilizer
- Legislation requirements are not met

Background

Fertilizers & Legislation requirements



Citrate soluble P
Water insoluble P → Insoluble impurities due the PR quality

Due lower grade PR

$$\frac{\text{WSP}}{\text{Available P}} \times 100 \rightarrow \text{“Fi”}$$

LEGISLATIO ≅ **90%**

N

(SSP, TSP, MAP, DAP)

Insoluble compounds do not seem to reduce agronomic effectiveness,

but..... ....the **Legislation Requirements** are not met.

Mullins and Sikora (1992, 1995)
Prochnow et al. (2003, 2008)

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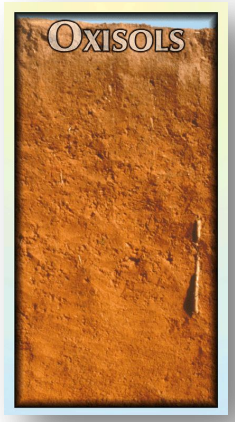
Objective

To evaluate the agronomic performance of SSP-based fertilizers varying in *"Fi Index"* to soybean in Oxisol of Brazilian Cerrado.



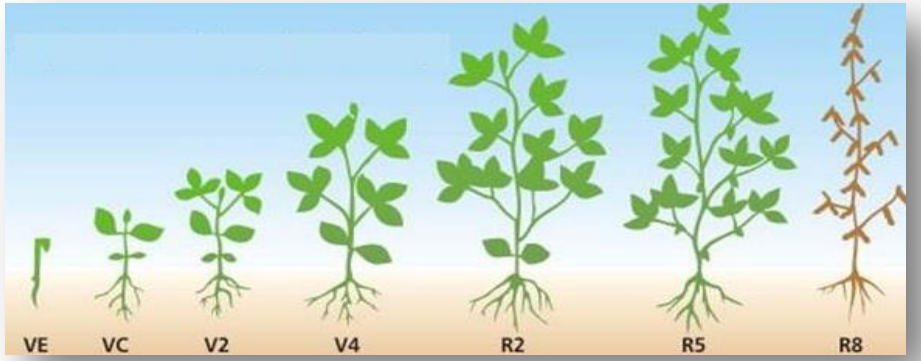
Methods

Overview

Itiquira - Mato Grosso

4 SSP-based fertilizers
(60 kg ha^{-1} P_2O_5)

Soybean (TMG 132 RR)



Oxisol (63% clay / MPAC: 1315 mg kg^{-1})

pH	P	S	K	Ca	Mg	Al	H+Al	SB	CTC	V	m	B	Cu	Fe	Mn	Zn
$CaCl_2$	mg dm^{-3}			mmol$_c$ dm^{-3}						%		mg dm^{-3}				
4,9	10	4	0,4	27	18	1	52	45,6	97,8	47	1	0,16	0,4	50	2,3	0,3

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Methods

Fertilizers treatments

Commercial SSP-based fertilizer → **LAGAMAR PR** (Northeast Brazil)

But, why Lagamar PR ?

- **High level of impurities**
- **Very difficult beneficiation**
- **Limited information available**

Fertilizer	PR	P_2O_5			Al_2O_3 + Fe_2O_3	Fi %
		Total	Citrate + H_2O	H_2O		
		%				
SSP-(60%)	Lagamar	18	17	10	2.8	59
SSP-(86%)	Catalão	22	21	18	1.3	86

Well-known = Reference

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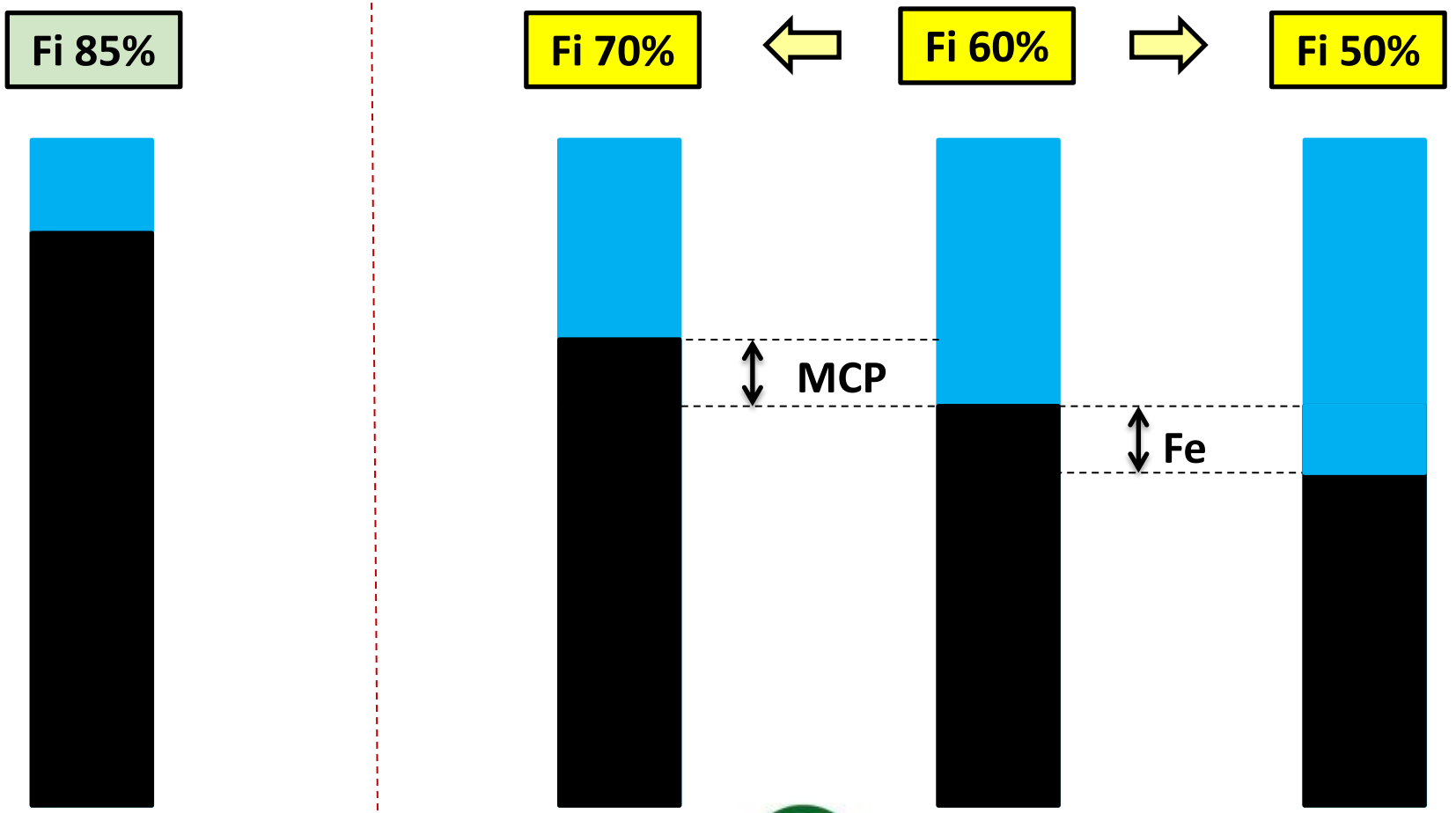
Methods

Fertilizers treatments

Standard source

Marginal sources (**legislation requirements not met**)



%

Available P

WSP

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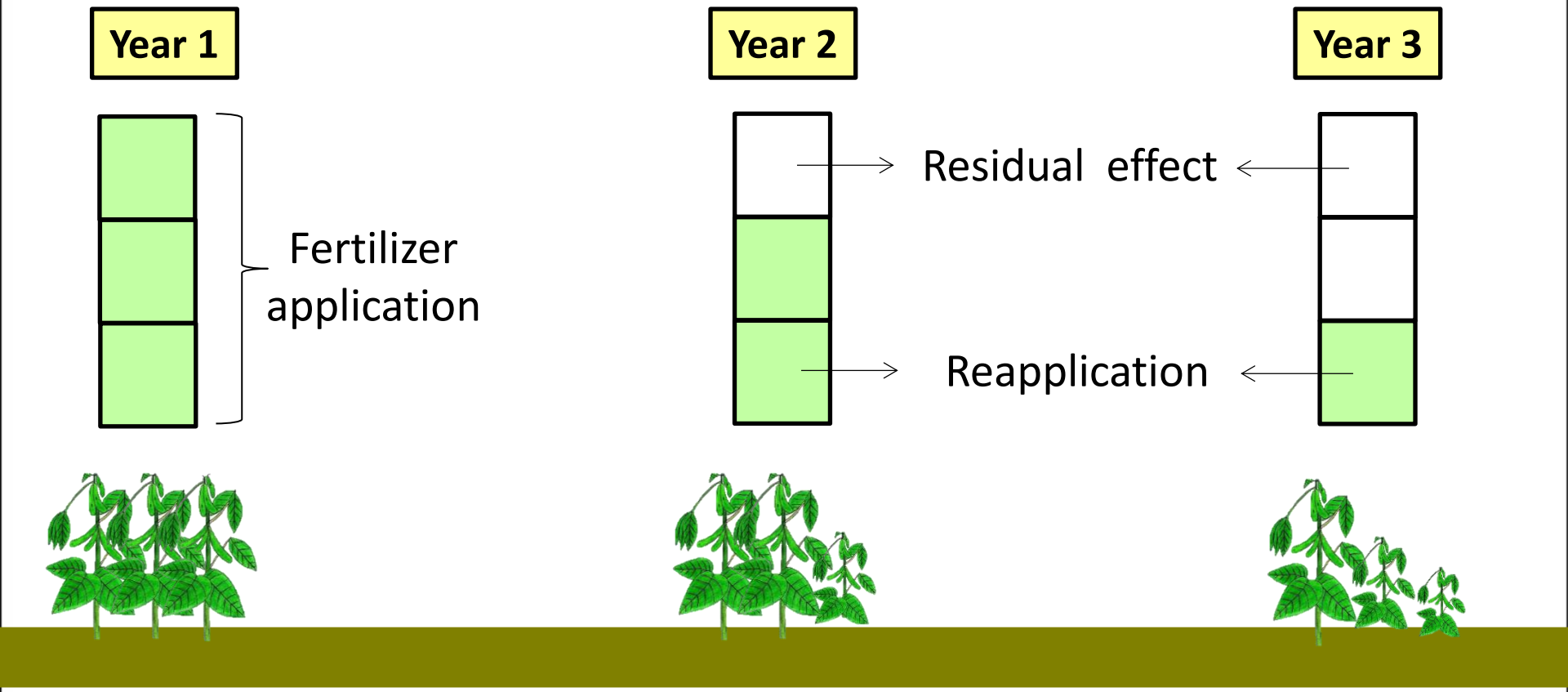
Methods

Design & Experimental units

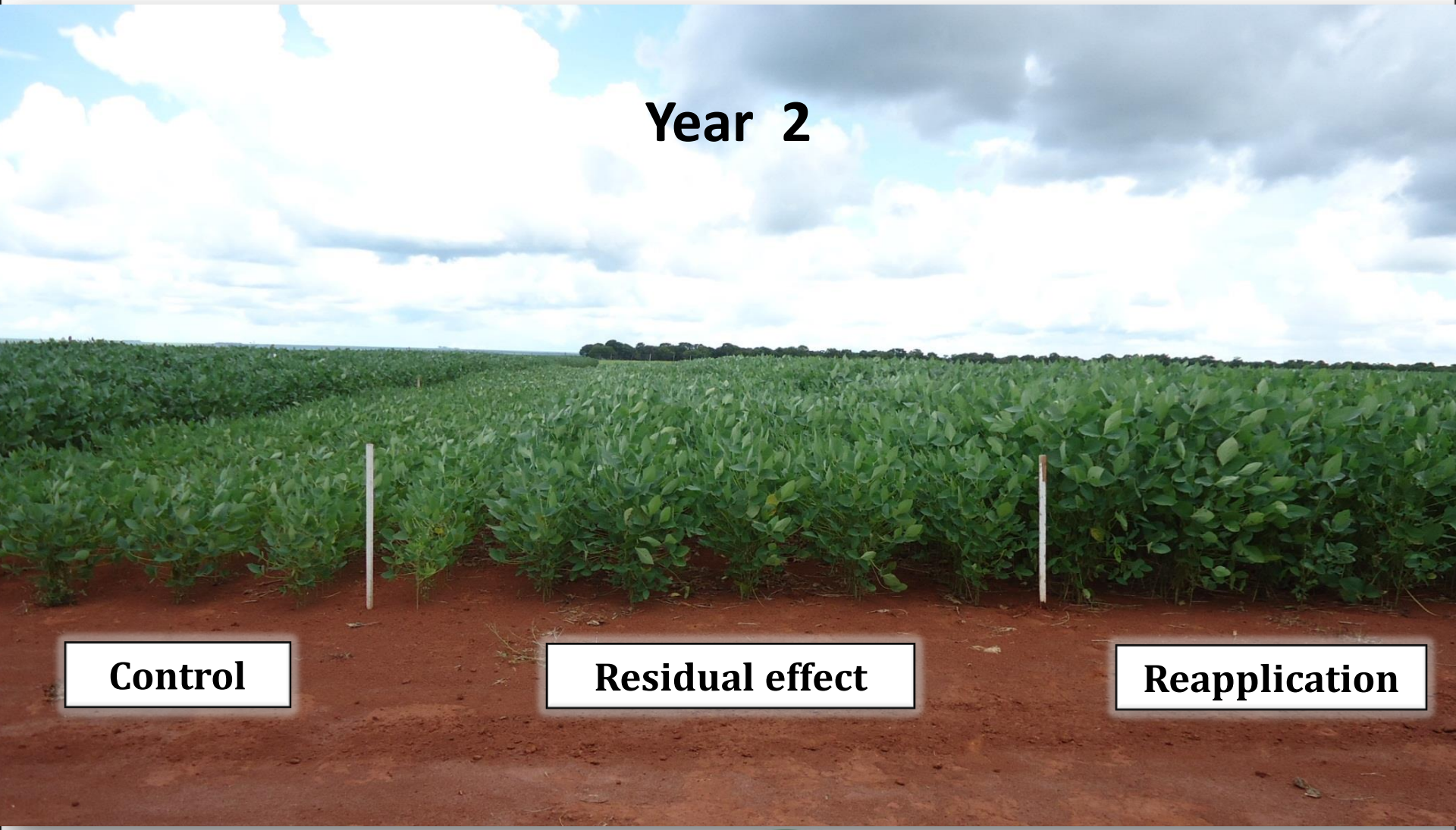


Evaluations

[i] Soybean Yield

[ii] Soil available P

Results

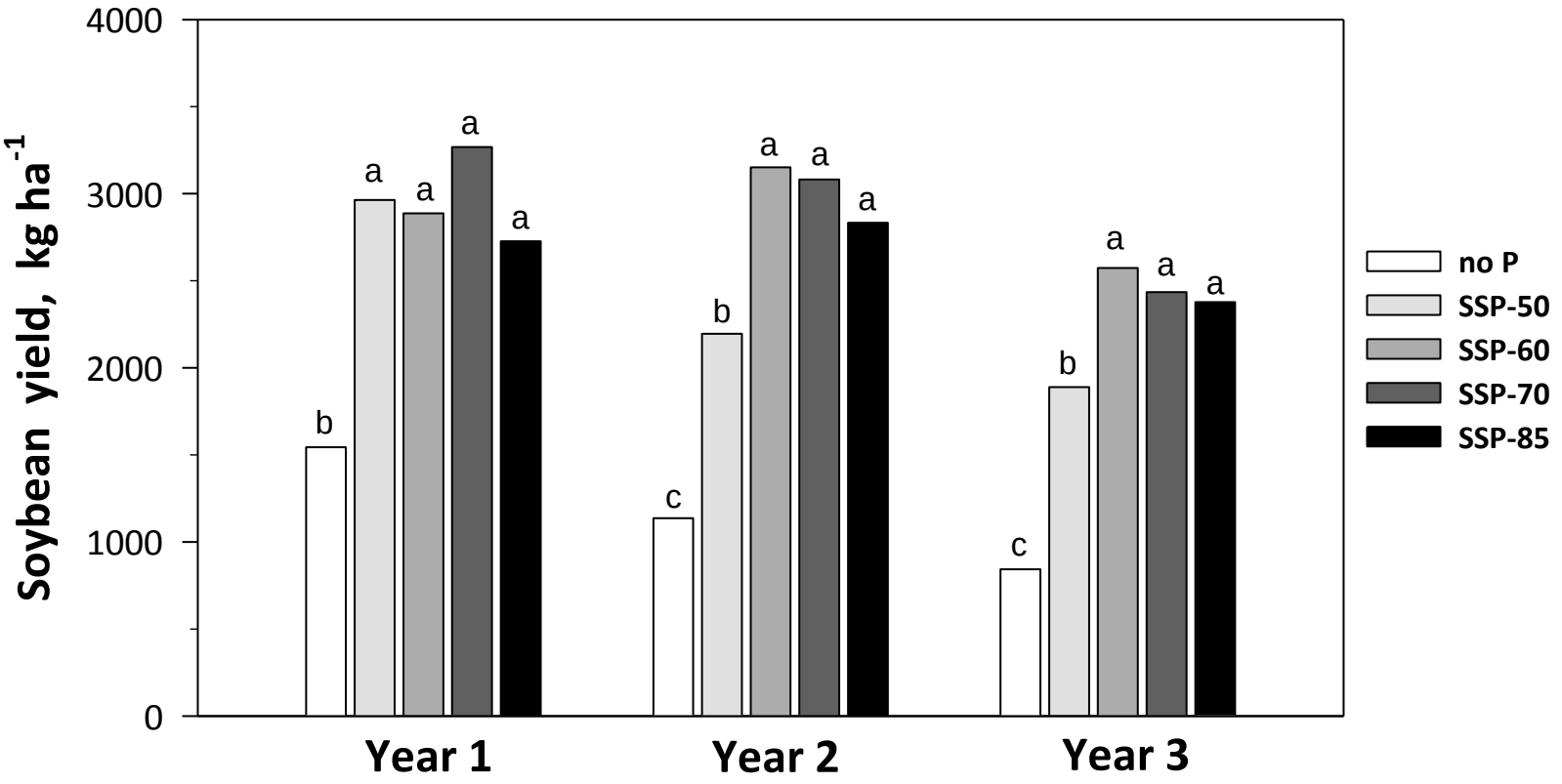


Results

Soybean Yield

Annual evaluation

Fresh fertilizer application to new plots



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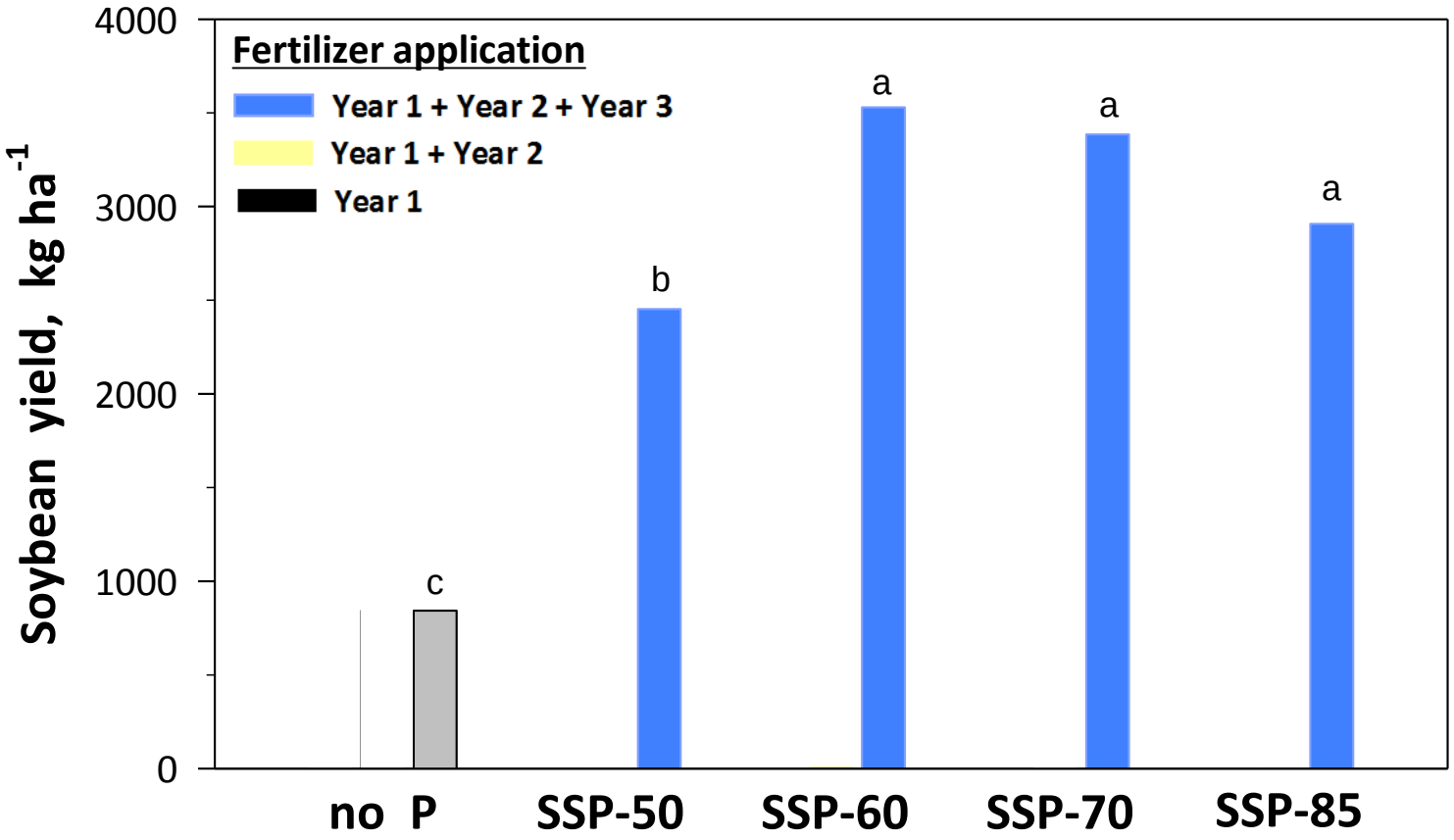
Results

Soybean Yield

Evaluation - year 3

Fresh application Vs residual effect



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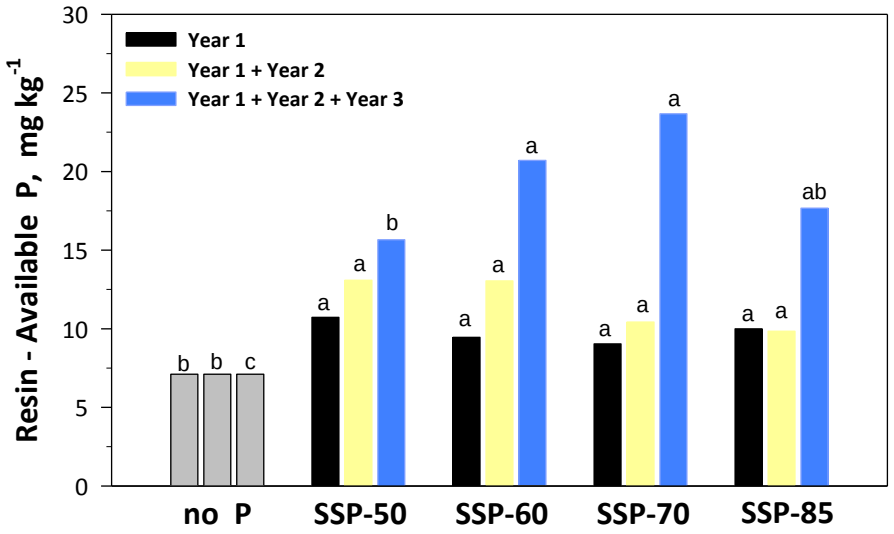
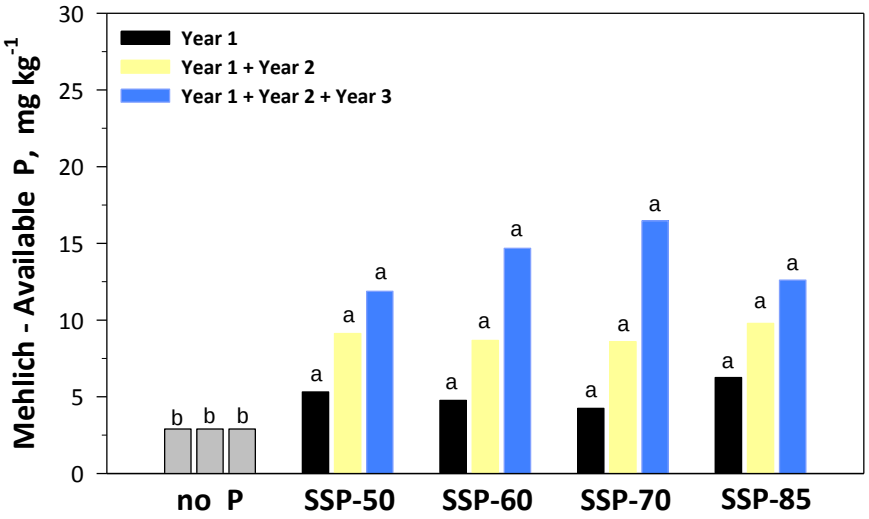
Results

Soil available P

Resin P



Mehlich P



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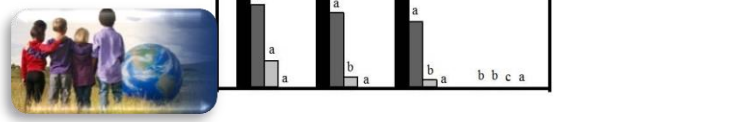
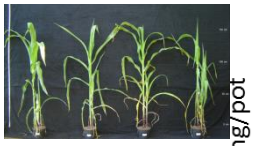
Implication

Fertilizer industry will be forced to process marginal PR resources.

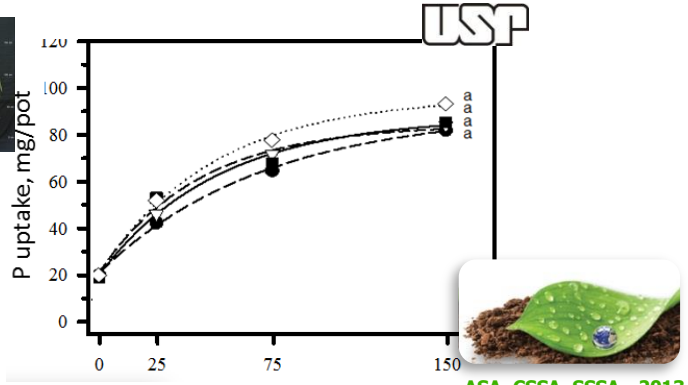
- To the best of our knowledge, lower grade SSP-based has not been evaluated yet <u>in long term under field conditions to validate previous findings of incubation and pot experiments</u>.



ASA, CSSA, SSSA - 2012



Silva et al. (unpublished)



ASA, CSSA, SSSA - 2013

- Results indicate the possibility of legislation revision in order to reduce the "Fi index" requirement, which would **<u>optimize the use of marginal grade PR.</u>**

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Conclusions

- The agronomic performance of SSP-based fertilizers is unlikely to be affected by insoluble P impurities (~ Fi 60%), despite the legislation requirements;

- SSP-based fertilizers with Fi as low as 60% can be agronomically as efficient as fertilizers with Fi ≥ 85%, even in a highly P fixing Oxisol;

- Acidulation of low grade PR is a reasonable option to obtain SSP-based fertilizers (even low Fi), mainly in countries that strongly depend on low grade phosphate resources.

Acknowledgements

Foundation for Supporting
Research in the State of Sao Paulo

Thank you !