

Fertilizer products from sewage sludge and meat and bone meal ashes

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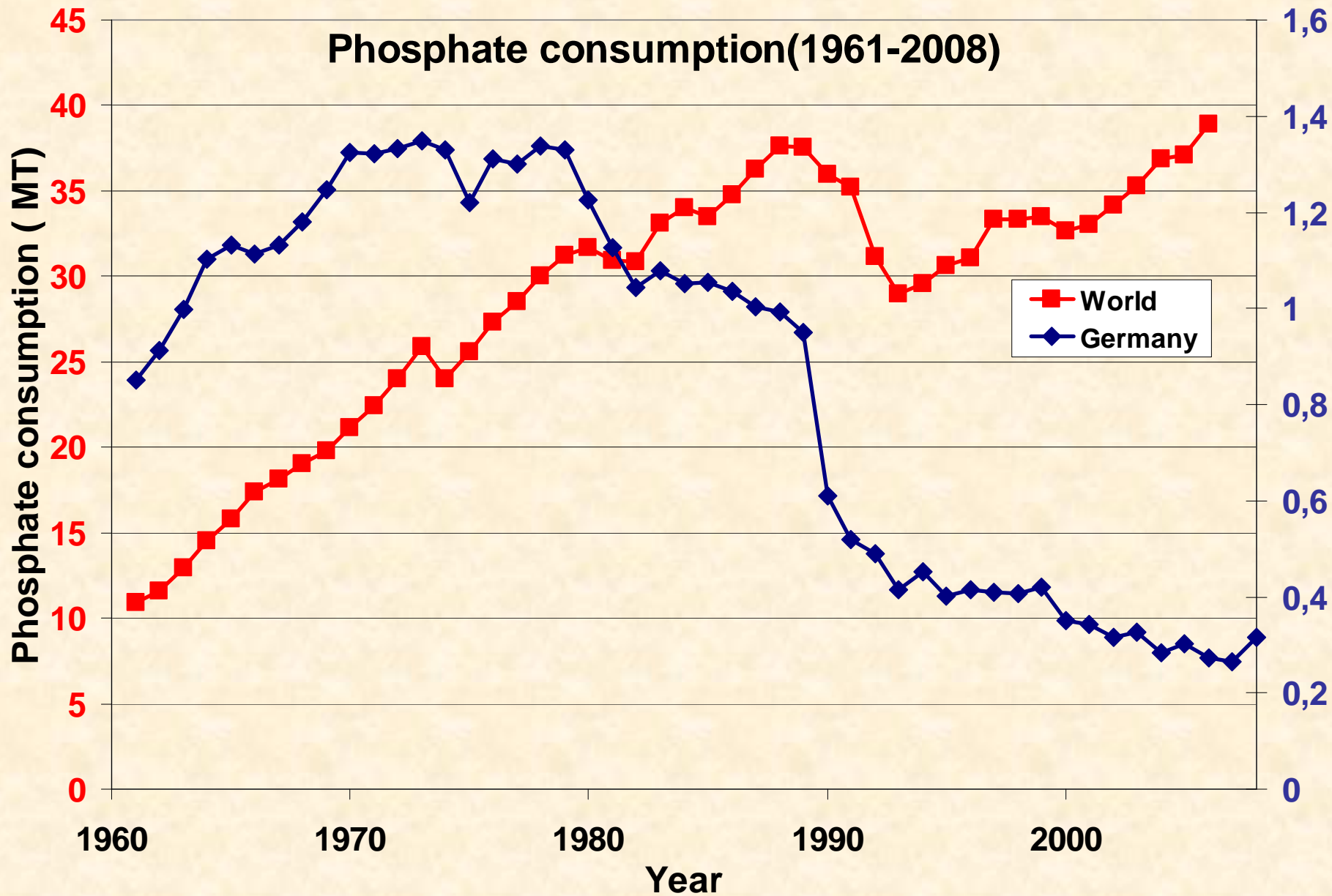
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Background

- Phosphorus is an essential nutrient

Phosphate consumption(1961-2008)



Background

- Phosphorus is an essential nutrient
- Phosphate reserves are limited and considerably exhausted
 - ➔ Phosphate reserves are sufficient for 100-400 years
- Quality of rock phosphate is decreasing
- Phosphorus can not be substituted as fertilizer
 - ➔ Use of phosphorus from secondary raw materials

Background

Situation in Germany

- about 130,000 tons of Phosphorus in agriculture
- calculated potential from secondary raw materials:
130,000 tons
- 2004: BMBF and BMU launched funding program „Recycling management of plant nutrients, phosphorus in particular“

Aim of the study

- To examine the products as for their effect as fertilizer
- To examine possible harmful impacts on the environment

Test strategy

sub-goal 1

Analysis of fertilization effects

sub-goal 2

Analysis of possible harmful effects

sub-goal 3

Recording of technical product quality

sub-goal 4

Ecological aspects of sustainability

Subtask 1

Solubility of Phosphorus

Subtask 3

Chemical characterisation of the products

Subtask 5

Physical and technical characterisation of the products

Subtask 6

Evaluation and operating procedures

Subtask 2

Fertilization effects in pot experiments

Subtask 4

Protection goal referred investigation

Test design

Pot experiments

- 15 products from different sources and processing technologies
- 0-control und 2 mineral fertilizer
- 2 soils with different soil texture and pH-value

Incubation experiment (without plants)

Pot experiment with maize

Tested products, 2008

Product name	Type of material	P _{total}	Fe _{total}	Mg _{total}	Ca _{total}	pH
MMA	Meat meal ash	171	10.4	10.1	236	10.0
SSA	Sewage sludge ash	100	44.2	15.0	163	3.9
MAP 1	Sewage sludge recyclate	148	1.7	102	18	8.6
MAP 2	Sewage sludge recyclate	175	26.6	67.3	99	8.6
MAP 3	Sewage sludge recyclate	170	5.9	102	5	8.2
PASH	Sewage sludge ash	109	1.1	11.3	194	8.3
Prophos	Waste water recyclate	104	0.4	4.2	214	7.3
RP	Rock phosphate fertilizer	182	0.9	2.5	359	8.1
TSP	Triple super phosphate	184	2.0	2.0	146	2.3

Concentrations in g/kg

Tested products, 2009

Product name	Type of material	P _{total}	Fe _{total}	Mg _{total}	Ca _{total}	pH
CaP	Sewage sludge recyclate	153	< 1	<1	298	12.7
CSH	Sewage sludge recyclate	83	2	12	121	6.9
Prophos II	Waste water recyclate	54	1	4	154	8.3
SSA II	Sewage sludge ash	70	67	56	104	8,5
SSA III	Sewage sludge ash	41	8	6	49	0.9
SSA IV	Sewage sludge ash	39	8	3	49	1.9
Pash II	Sewage sludge ash	95	< 1	4	86	5,1
Pash III	Sewage sludge ash	71	<1	6	140	5,0

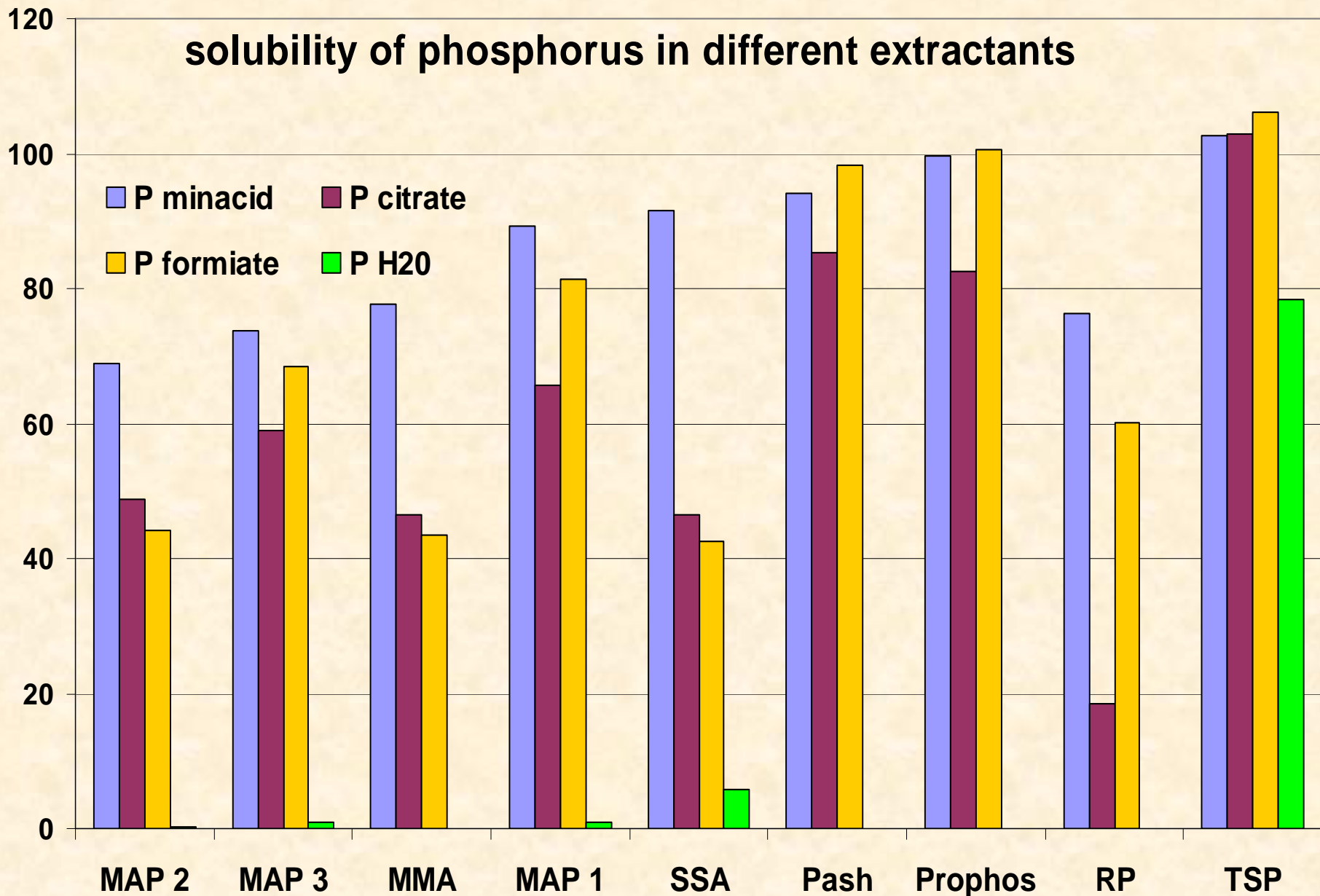
Concentrations in g/kg

Characteristics of test soils

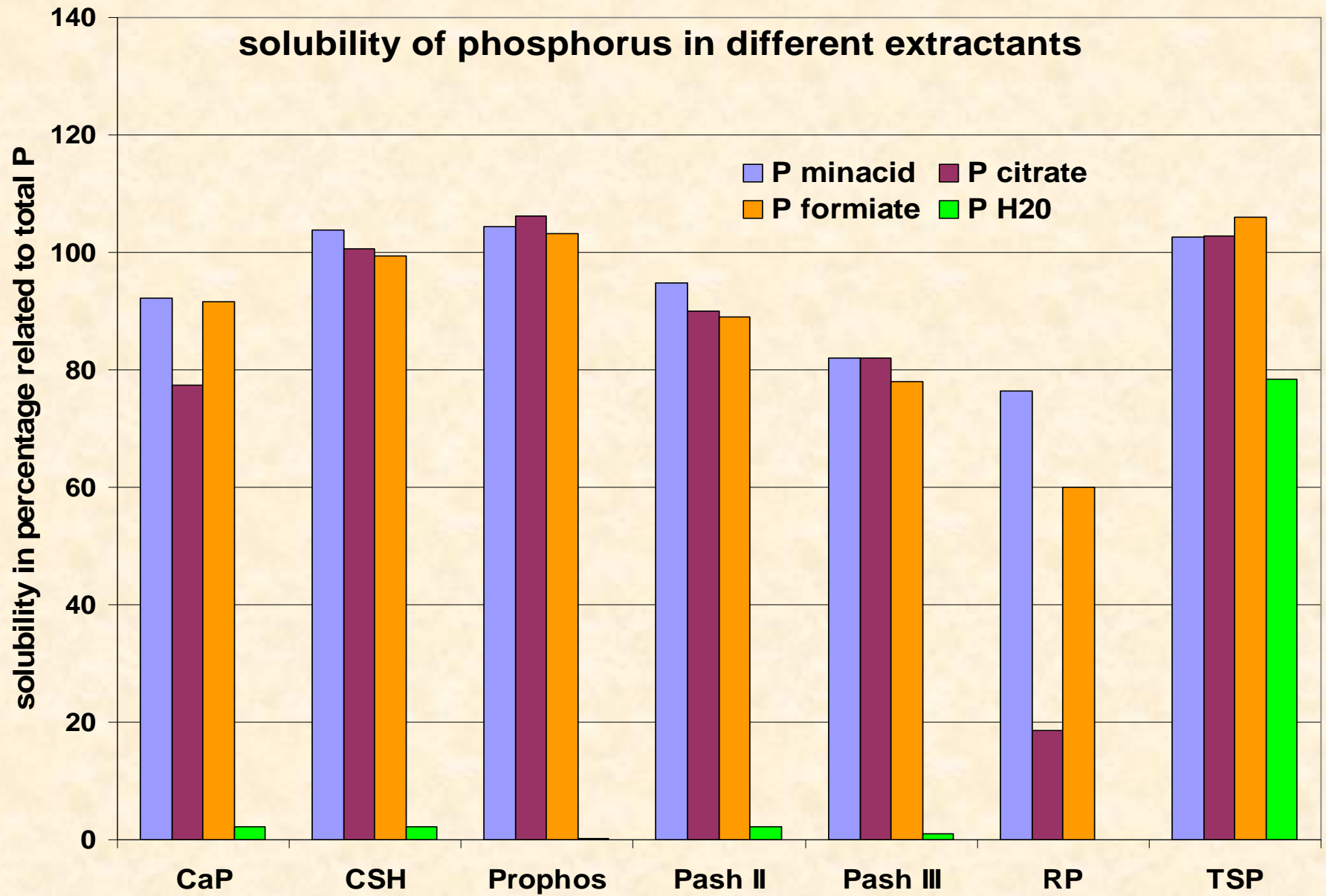
	unit	Sandy soil	Loamy soil
Sand	g/kg	890	440
Silt	g/kg	1	270
Clay	g/kg	10	290
pH (CaCl ₂)		4,86	6,32
C (total)	g/kg	26,8	16,8
N (total)	mg/kg	1389	2123
P (total)	mg/kg	330	580
P (plant available)	mg/kg	71	37
Al (total)	mg/kg	1660	19980
Fe (total)	mg/kg	570	12140
CEC _{eff}	mmolc/kg	56,1	188,7

solubility of phosphorus in different extractants

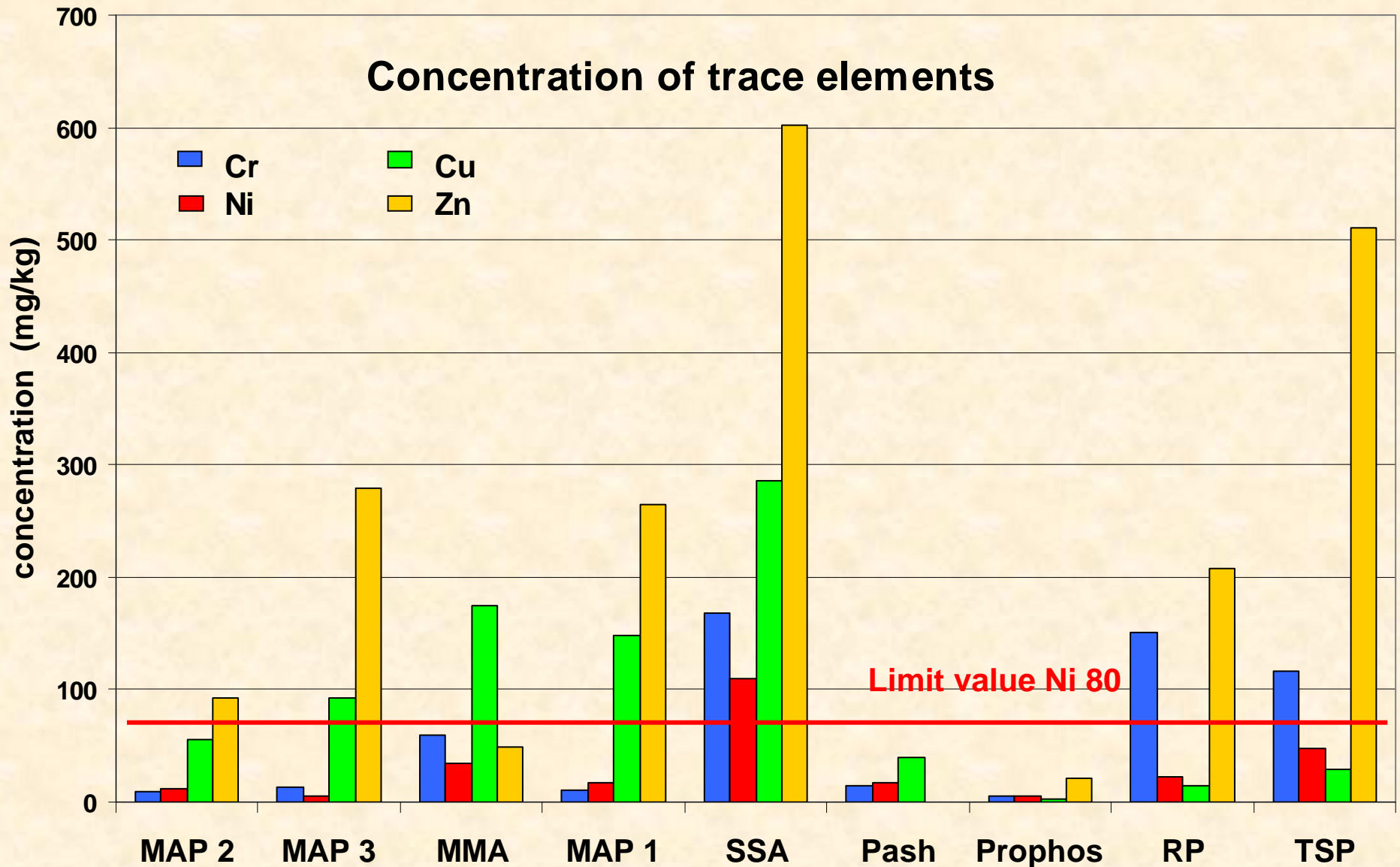
solubility in percentage related to total P



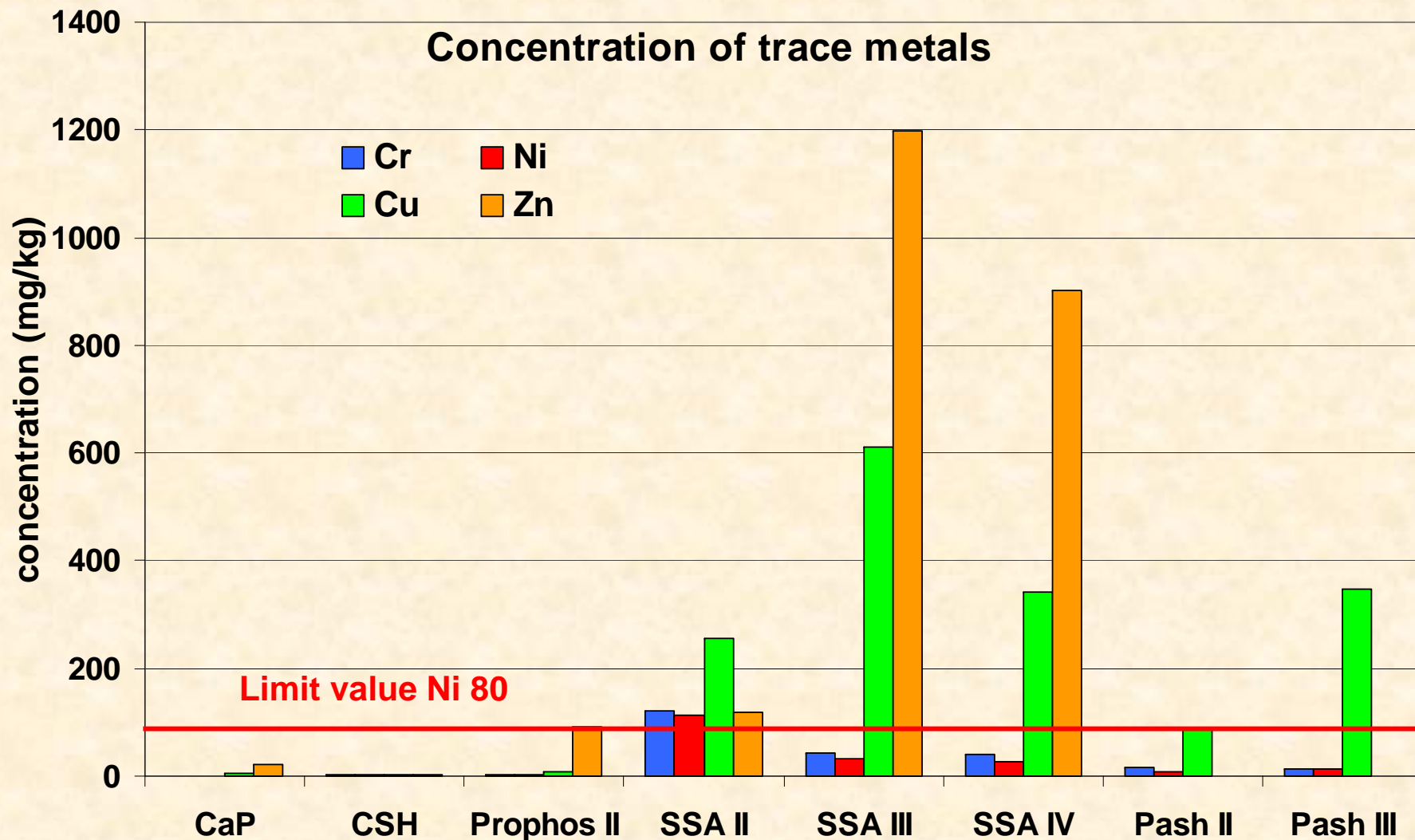
solubility of phosphorus in different extractants



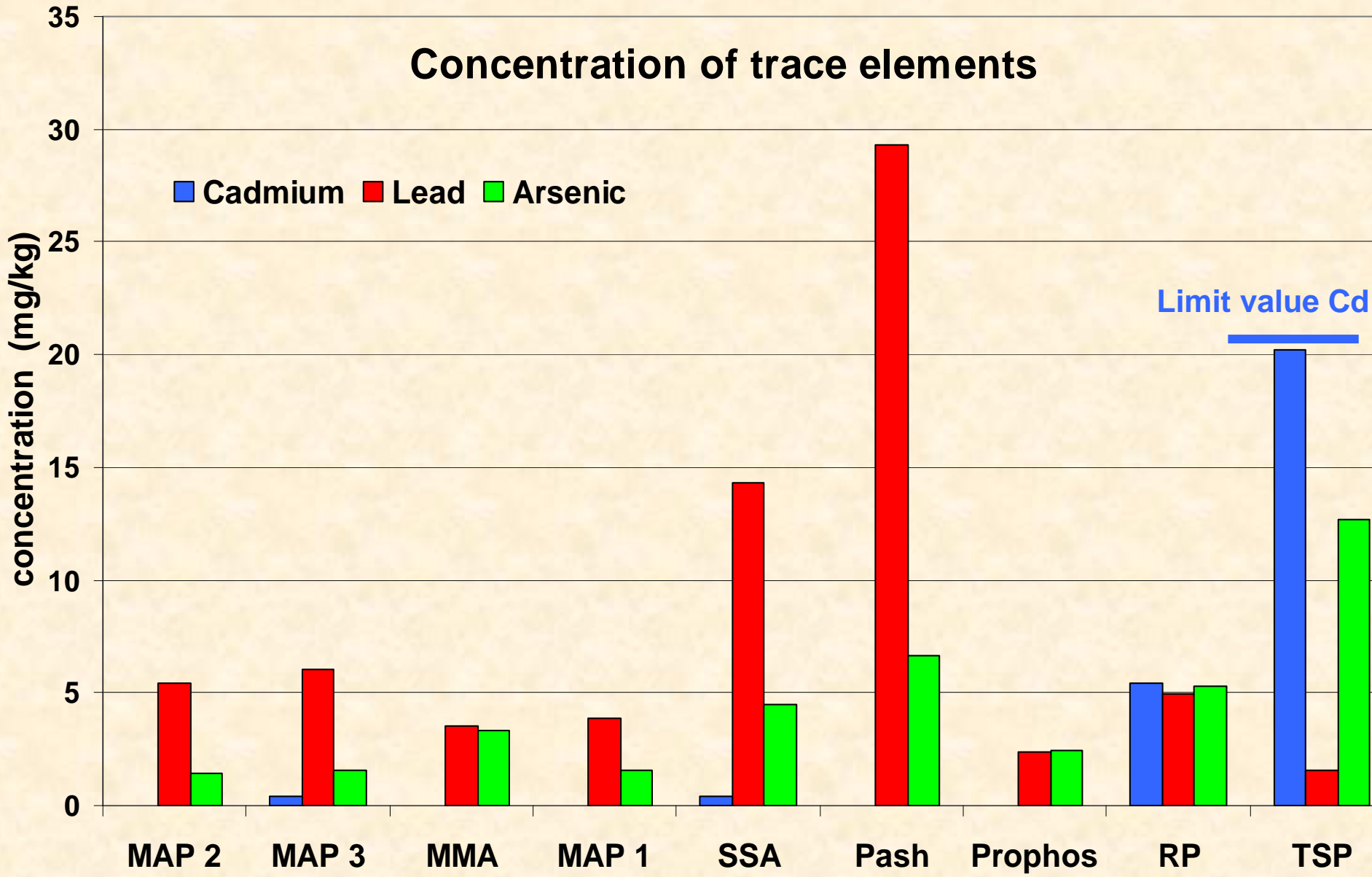
Concentration of trace elements

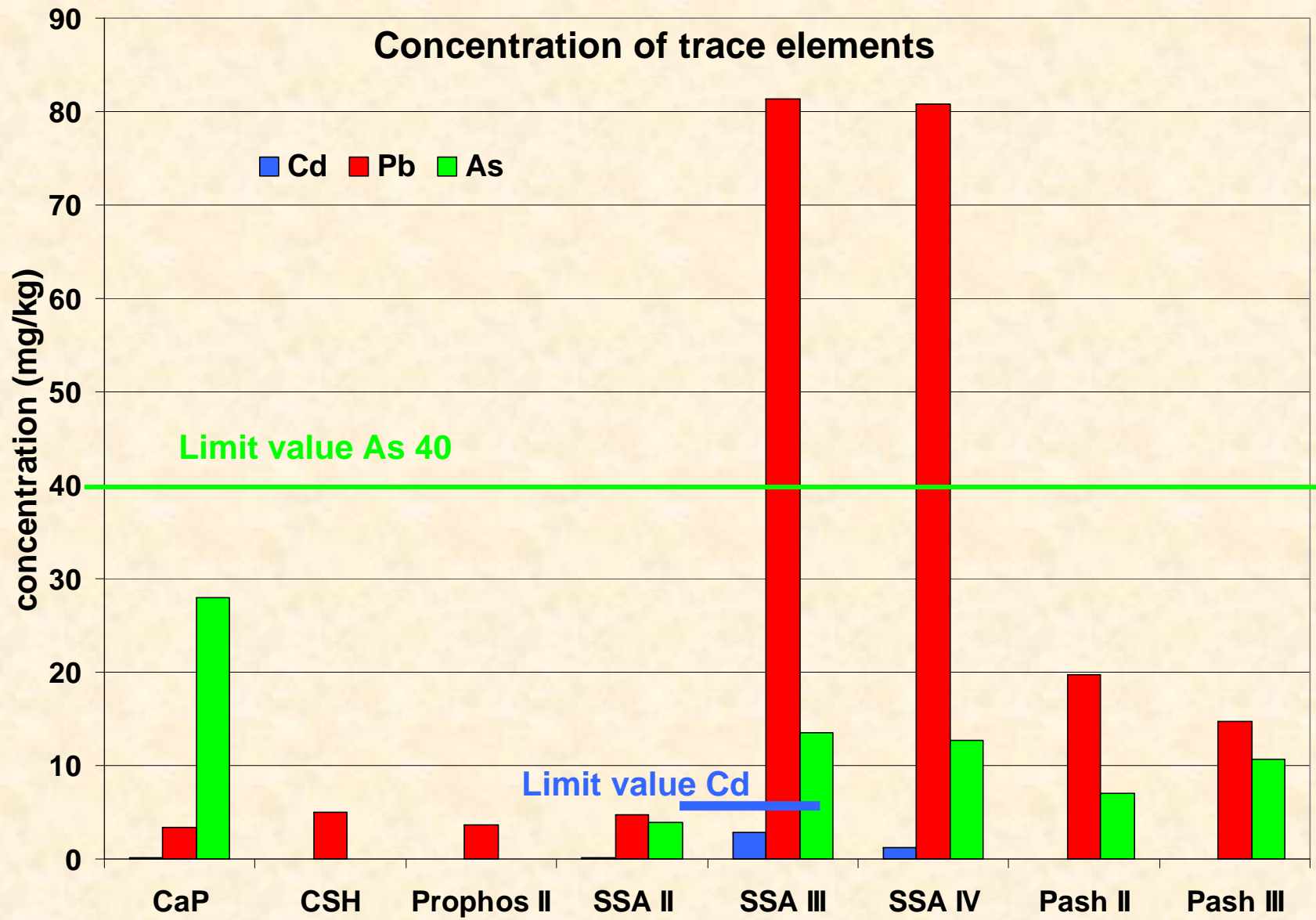


Concentration of trace metals

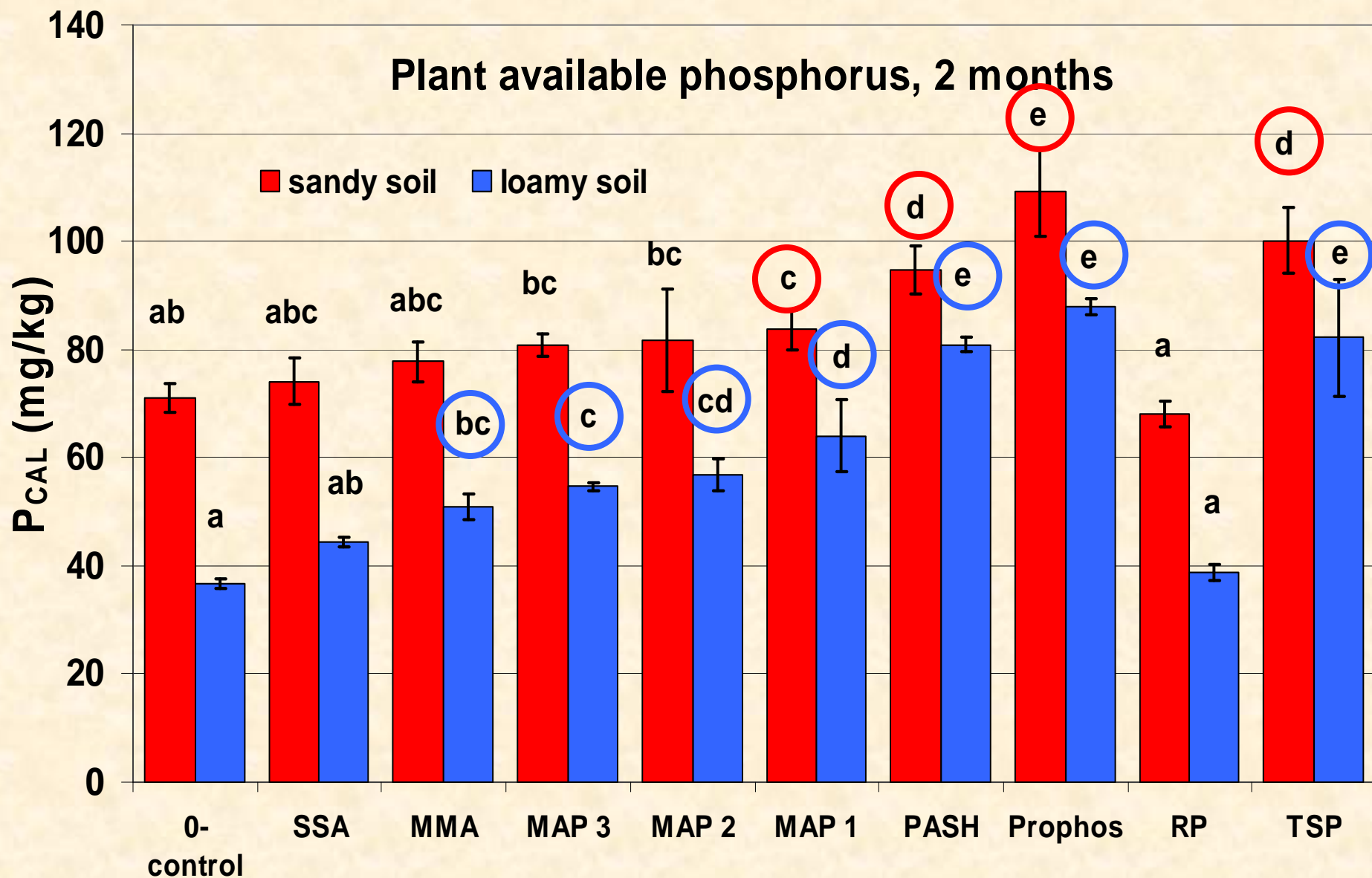


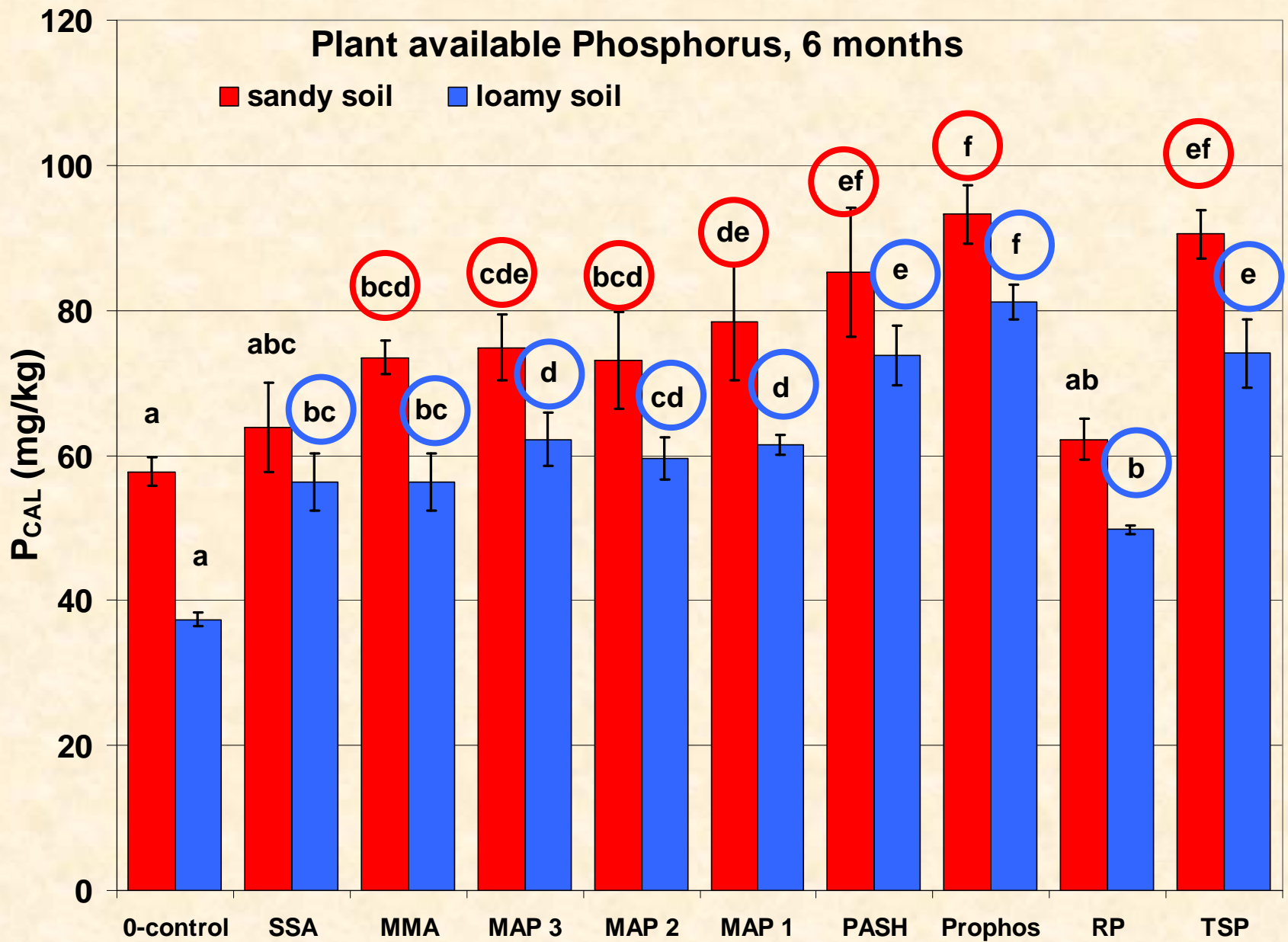
Concentration of trace elements



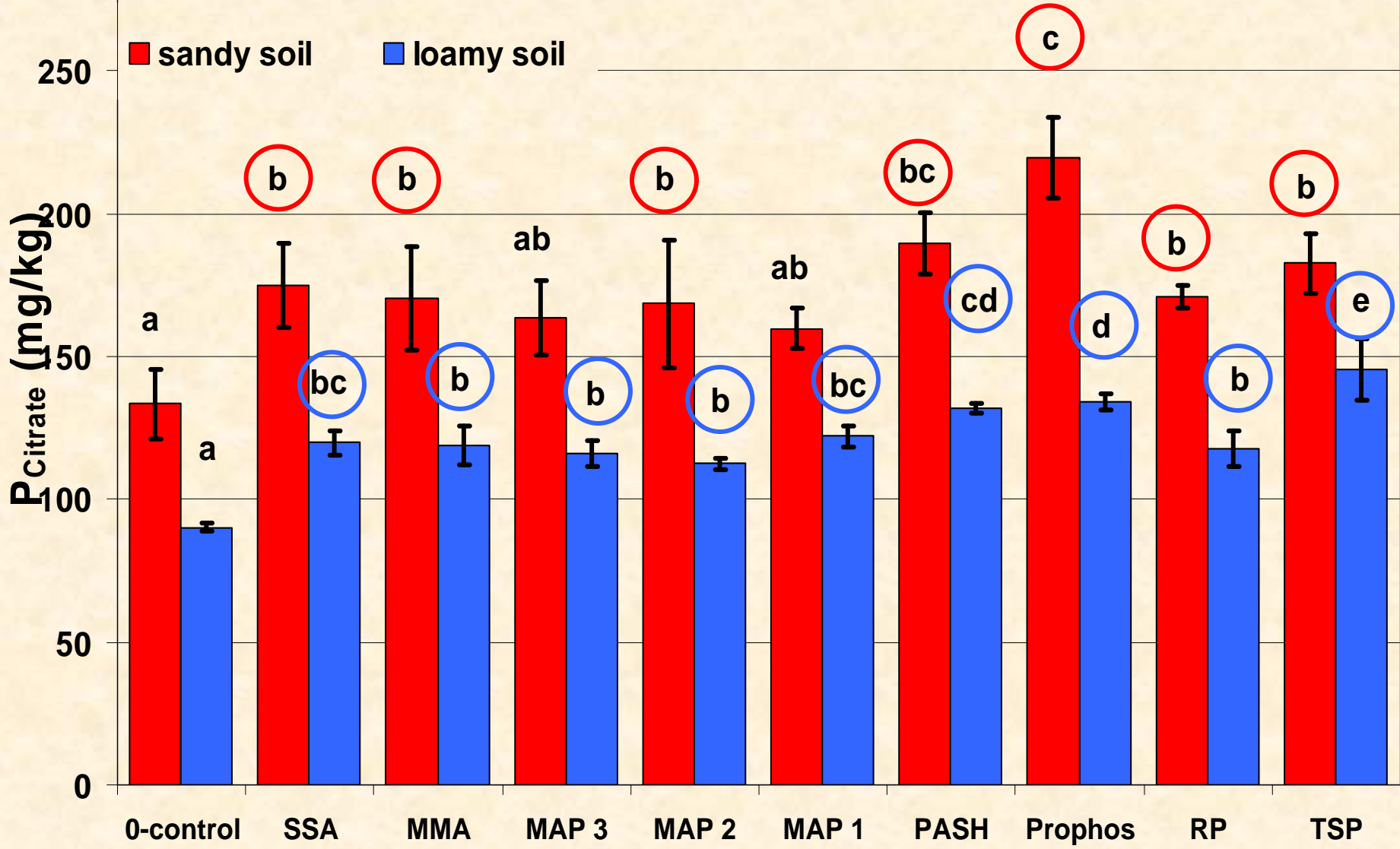


Plant available phosphorus, 2 months

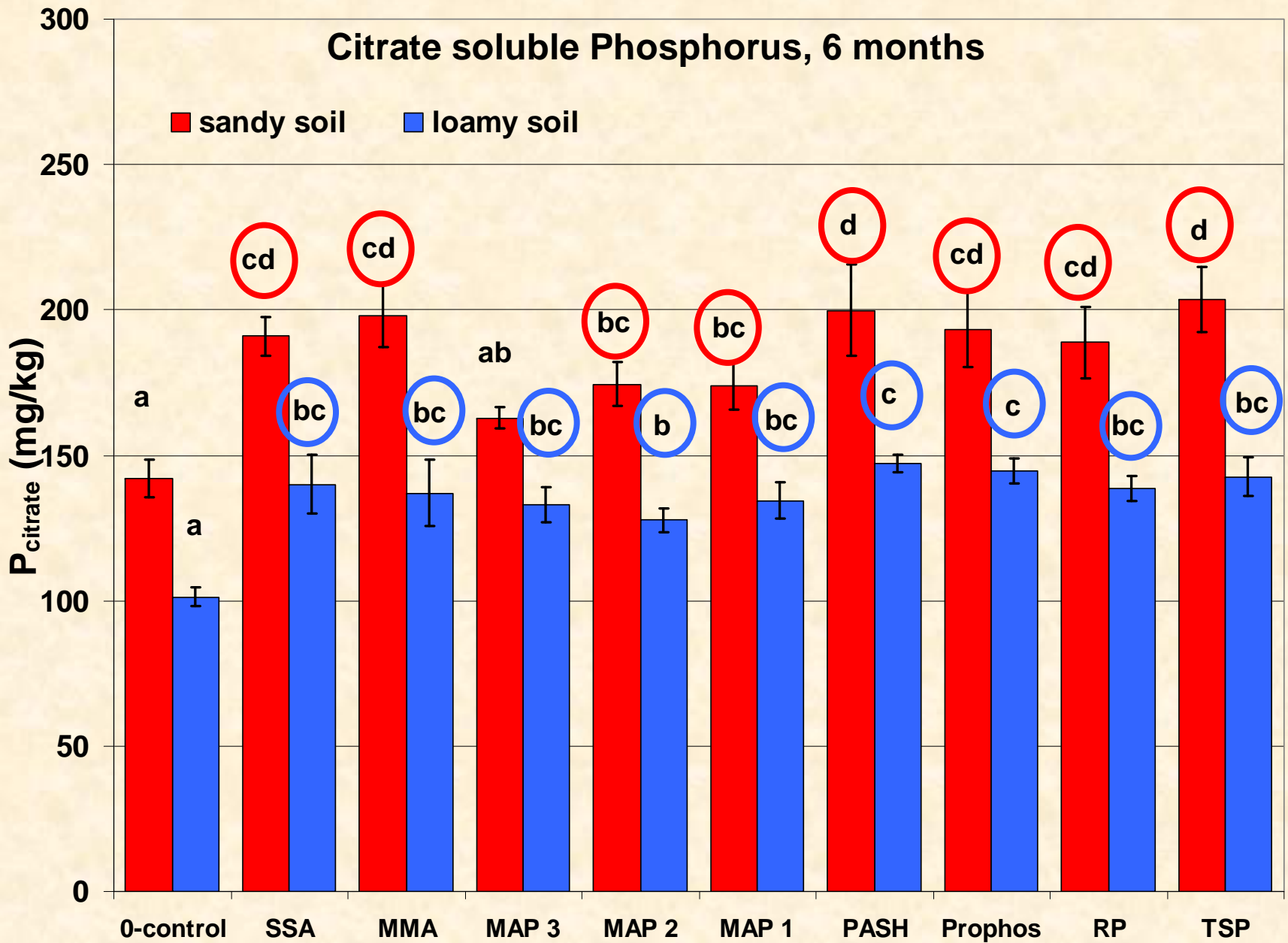




Citrate soluble Phosphorus, 2 months



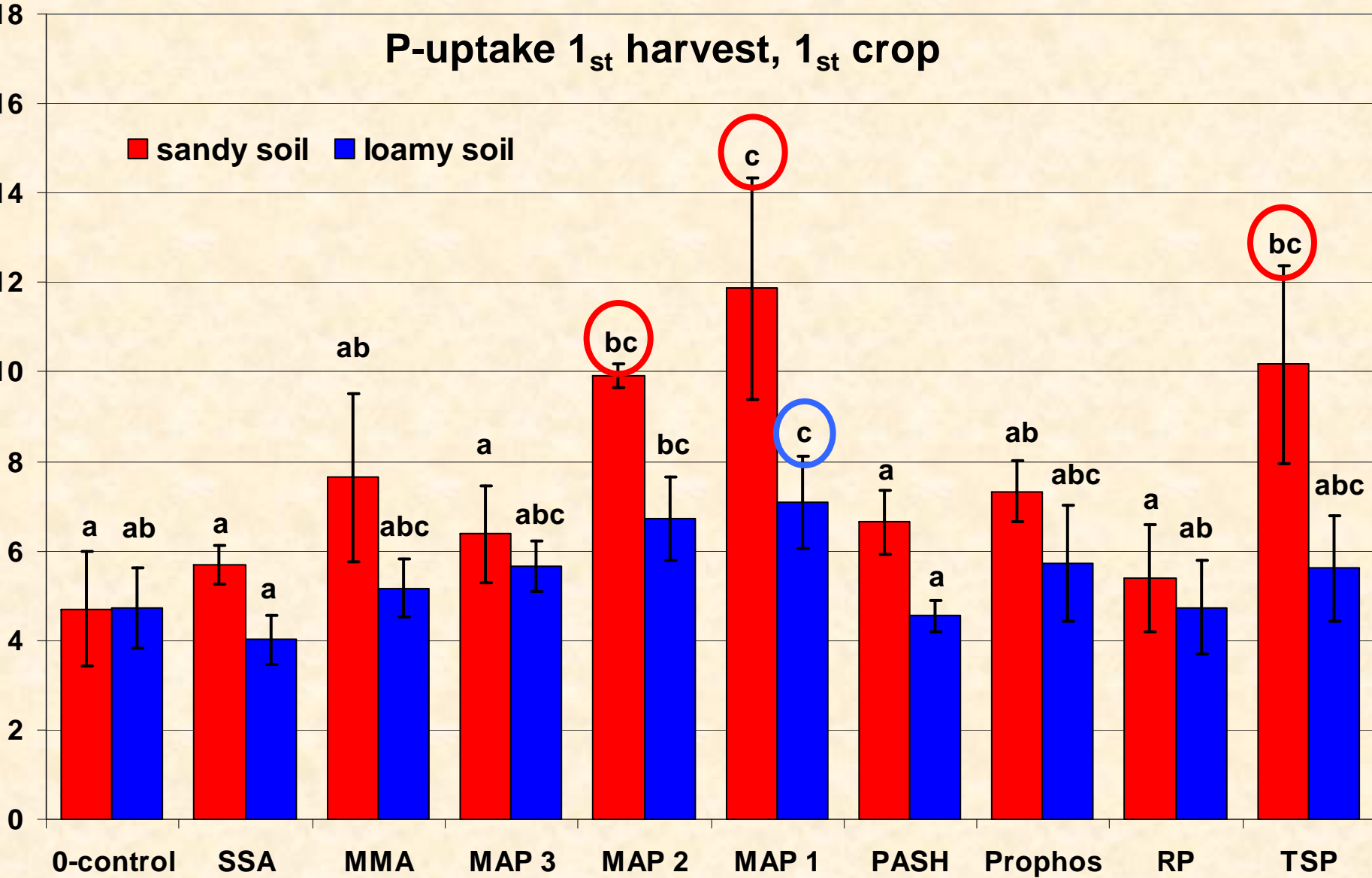
Citrate soluble Phosphorus, 6 months



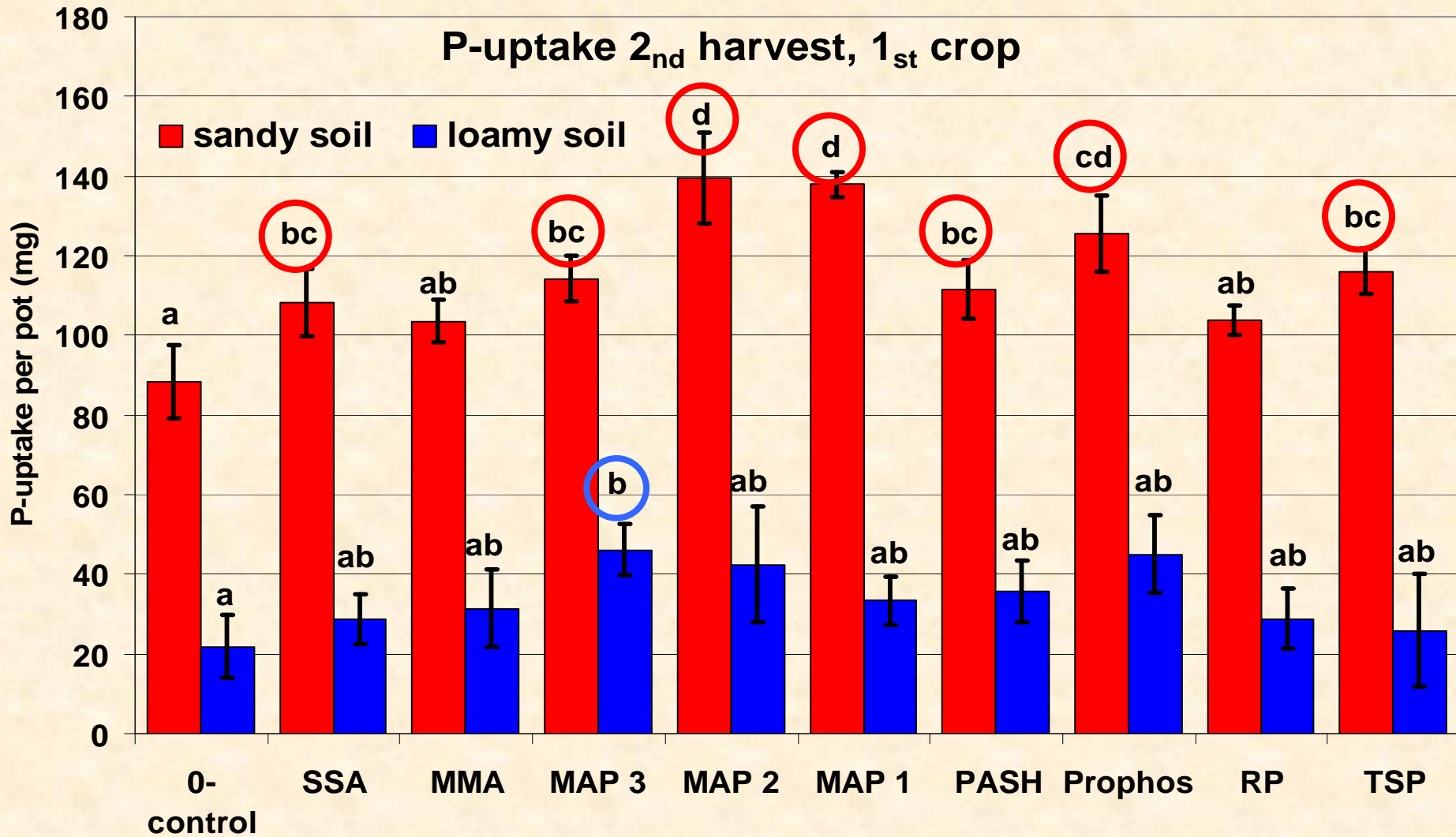
P-uptake 1_{st} harvest, 1_{st} crop

■ sandy soil ■ loamy soil

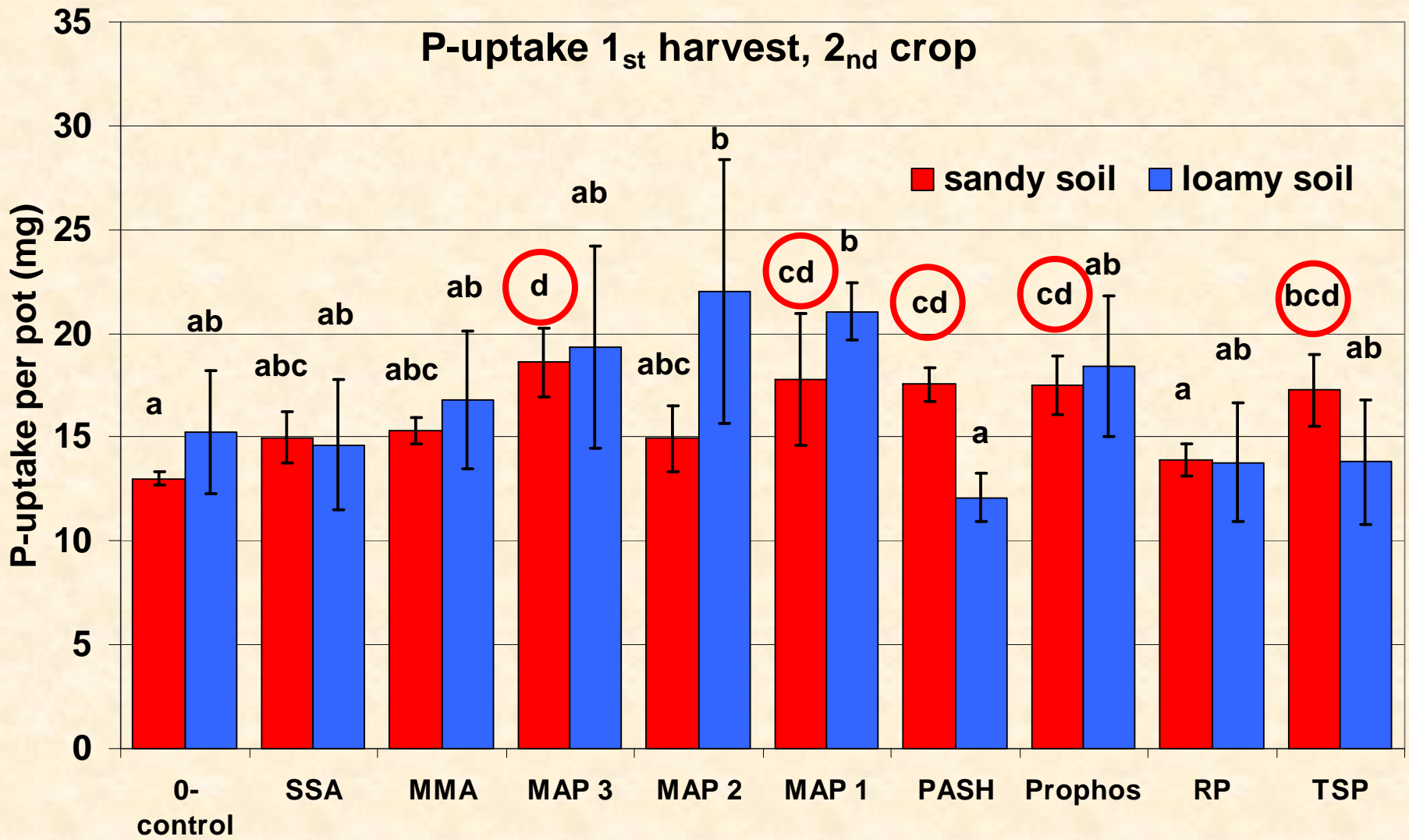
P-uptake per pot (mg)



P-uptake 2_{nd} harvest, 1_{st} crop



P-uptake 1_{st} harvest, 2_{nd} crop



Summary:

The most products show good efficiency related to the P-supply in the soils

The efficiency on P-uptake depends on the soil

The efficiency in the loamy soil is low and mostly not significant

In the sandy soil the most products increase P-uptake significantly

The trace metal concentrations are low

The products should be used for base fertilizing

Acknowledgement

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Thank you for your attention

Oxalate soluble Phosphorus

