



# MTT/Plan Production Research

Our research on the TraP project focused on the effects of gypsum application to element mobility in the soil profile, and the effects on the quantity and quality of harvested yield.

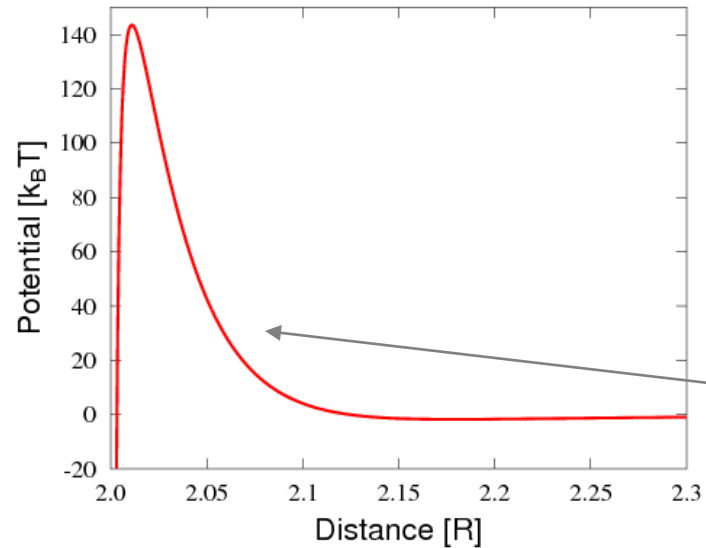
# Main results

- Percolation water contained clearly less soil matter and phosphorus when gypsum was applied to soil
- These positive effects lasted at least 2 years from gypsum applications, and it was estimated that the effect is over in 3-4 years
- Gypsum had no clear effect on yield quantity nor market quality
- However, gypsum hampered selenium uptake of plants
- Because gypsum application increases leaching of potassium and magnesium, the concentrations of these elements in soils should be monitored upon repeated gypsum treatments

# The study in practice included

- Application to fields and coring soil cylinders to indoor rainfall simulations where
  - other variables than the treatment are set to equal
  - straightforward interpretation of treatment effects, gypsum treatment was compared to lime treatment and unamended control treatment
- Yield effects were monitored on four fields
  - plants grown were perennial grass and wheat

# Theory of gypsum effects on erosion and phosphorus losses

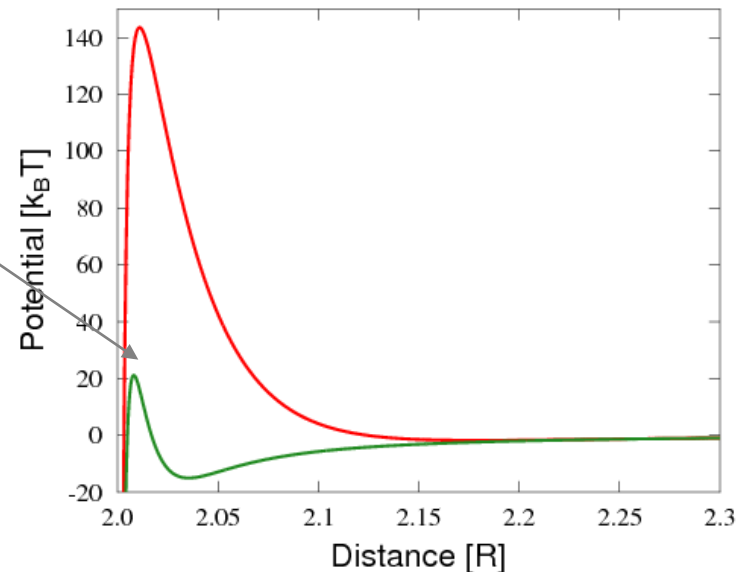


In soils with low concentration of soluble salts, particles remain in solution. Soil slakes and erodes easily.

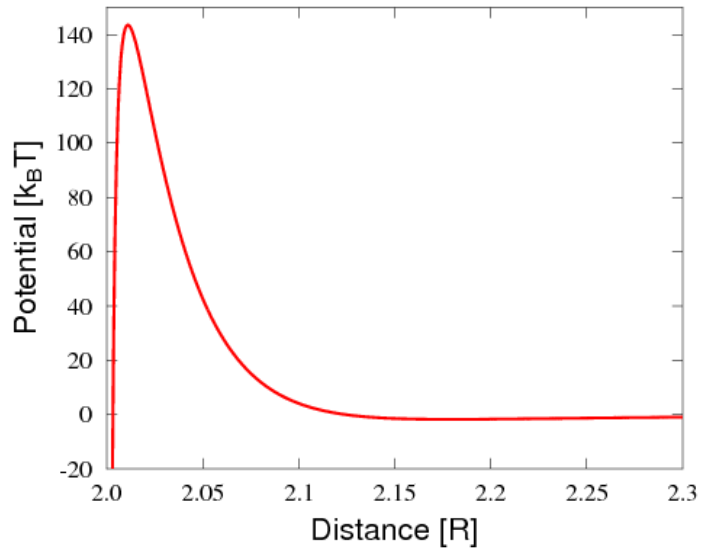
Repulsion between individual particles is high when the particles approach each other.

# Theory of gypsum effects on erosion and phosphorus losses

Gypsum application increases salt concentration of soil solution. Increased salt concentration lowers the inter-particle repulsion threshold and particles start to aggregate.

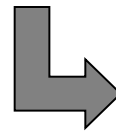


# Theory of gypsum effects on erosion and phosphorus losses

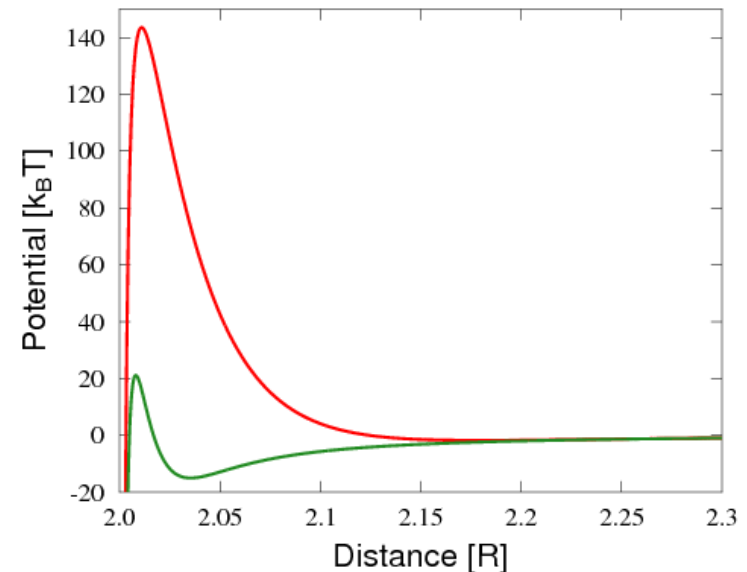


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+  $\text{CaSO}_4$

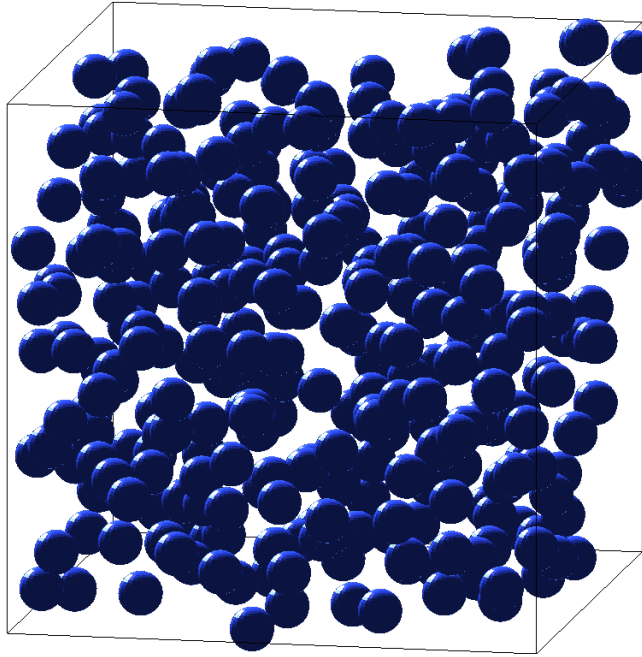


$\text{Ca}^{2+}$   
+  
 $\text{SO}_4^{2-}$



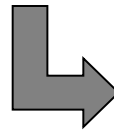
An increase in salt concentration upon dissolution of gypsum promotes aggregation and decreases soil slaking.

# Theory of gypsum effects on erosion and phosphorus losses



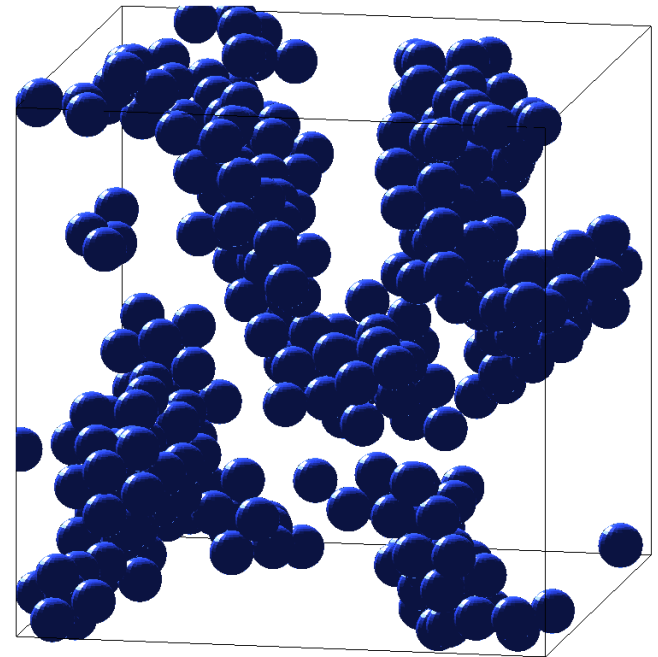
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+ CaSO<sub>4</sub>



Ca<sup>2+</sup>  
+  
SO<sub>4</sub><sup>2-</sup>

An increase in salt concentration upon dissolution of gypsum promotes aggregation and decreases soil slaking.



# Soil coring and rainfall simulations



# Gypsum application decreased turbidity (dispersed clay) in percolation water

May  
2009:

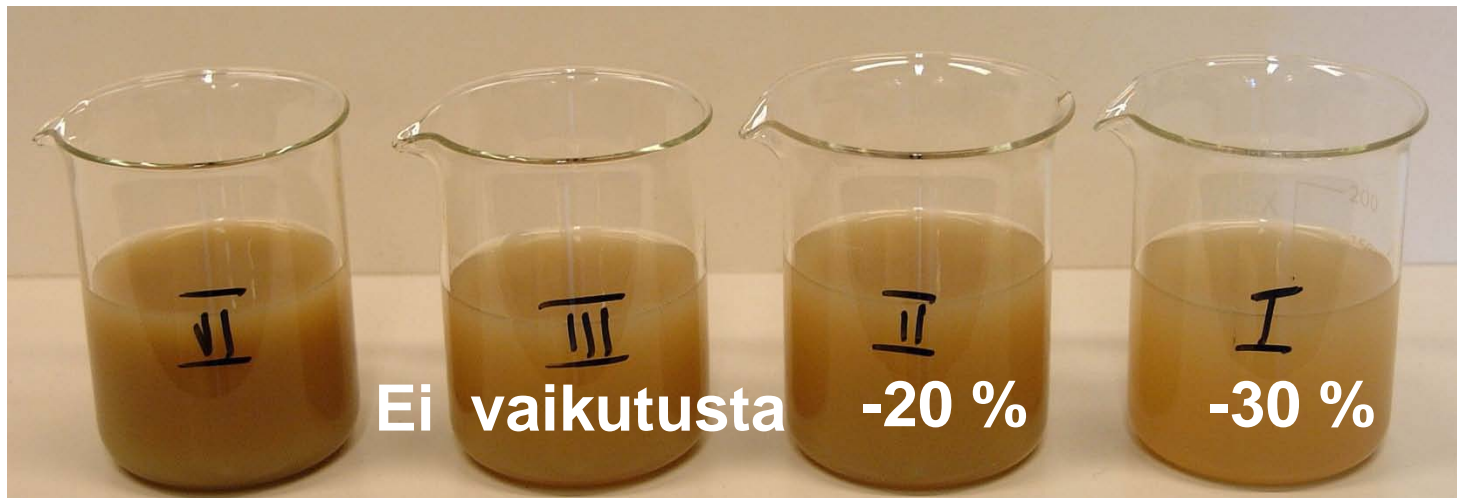


Unamended

Limestone

Gypsum 6 tn/ha

May  
2010:



Unamended

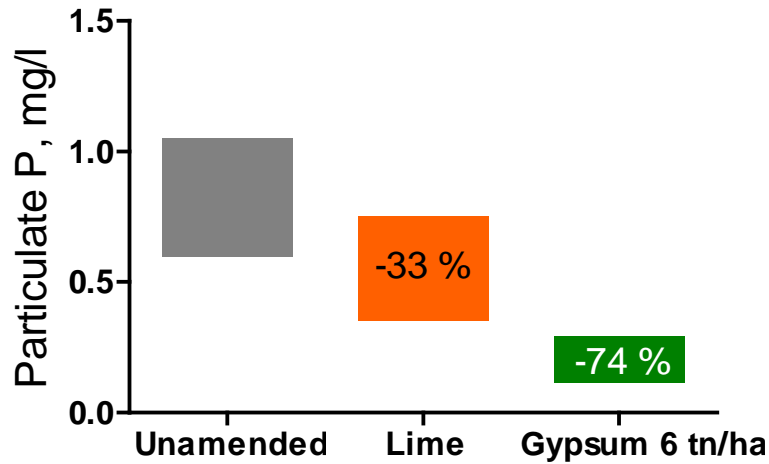
Limestone

Gyp 3 tn/ha

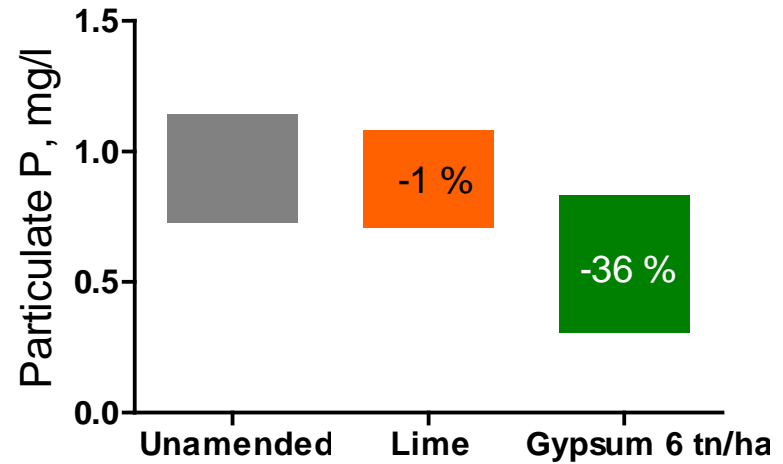
Gyp 6 tn/ha

In rainfall simulations gypsum application (6 tn/ha) lowered the concentration of particulate P in percolation water by 75% during the first year and by 45% during the second year after application.

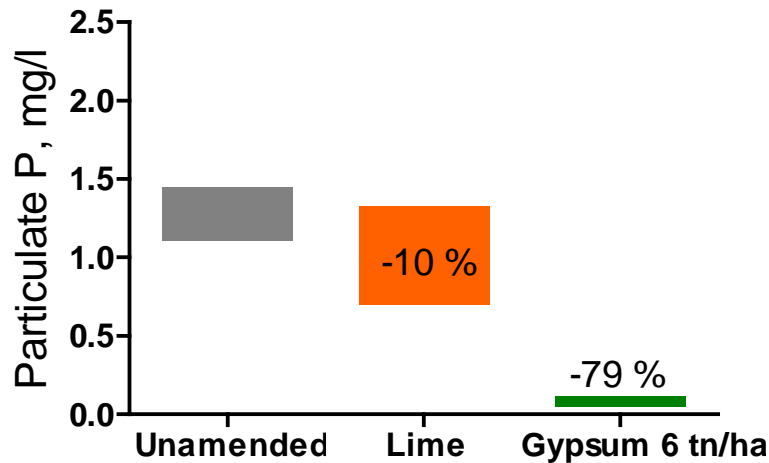
Ploughed, 2009



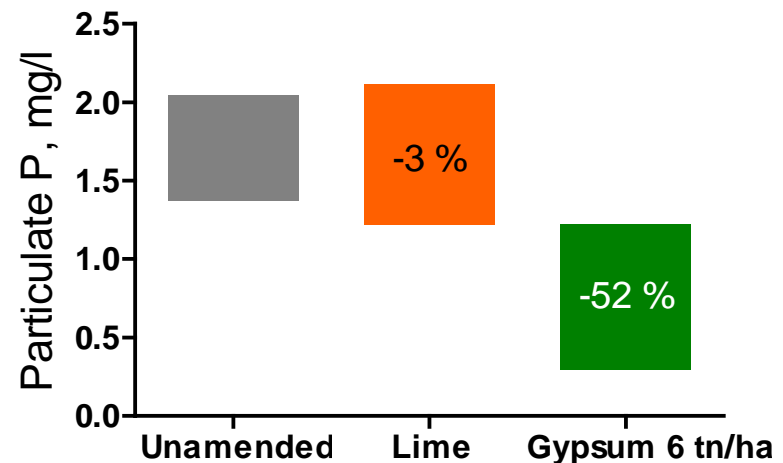
Ploughed, 2010



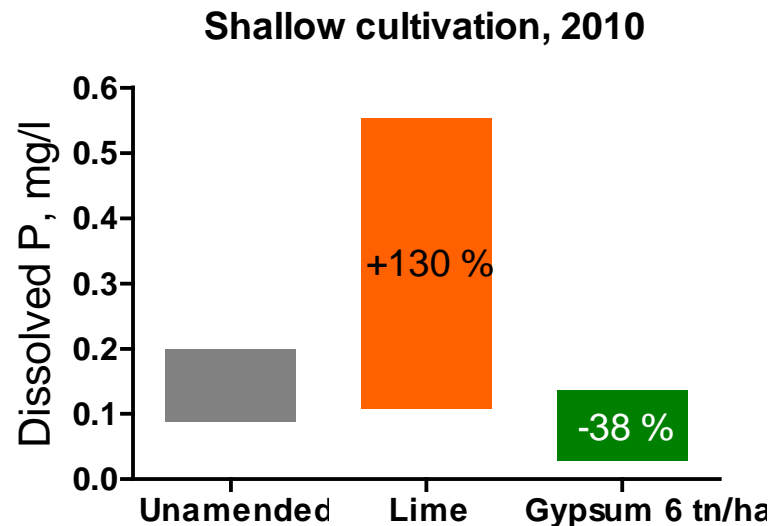
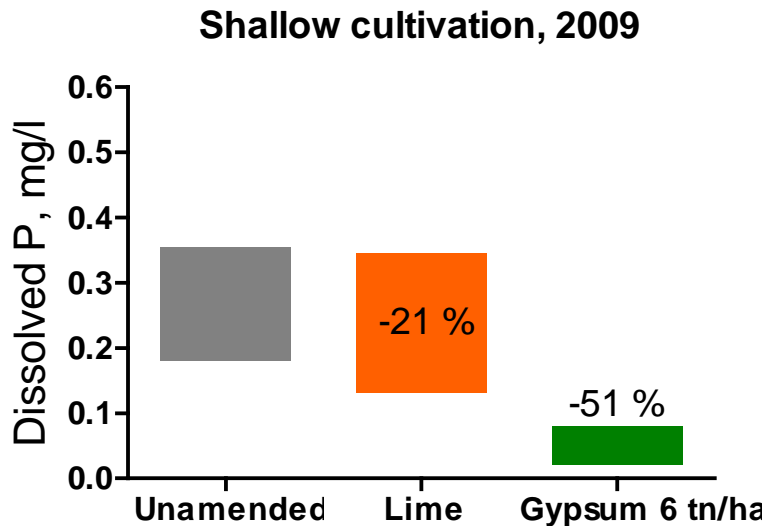
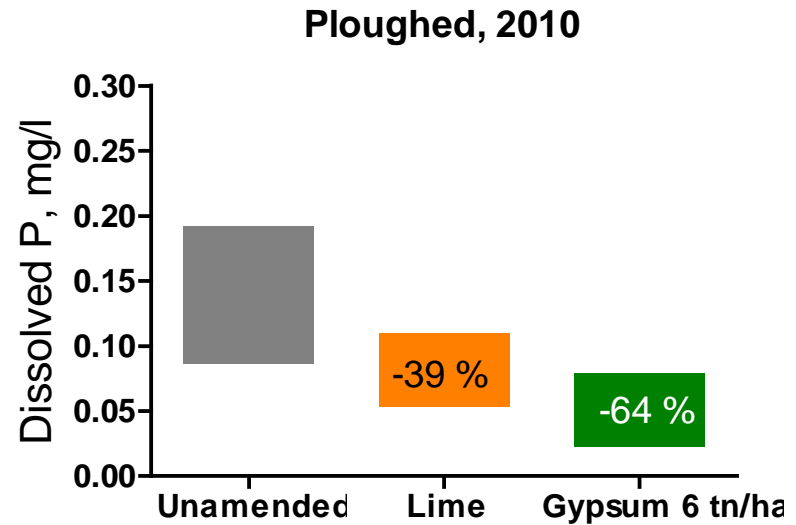
Shallow cultivation, 2009



Shallow cultivation, 2010



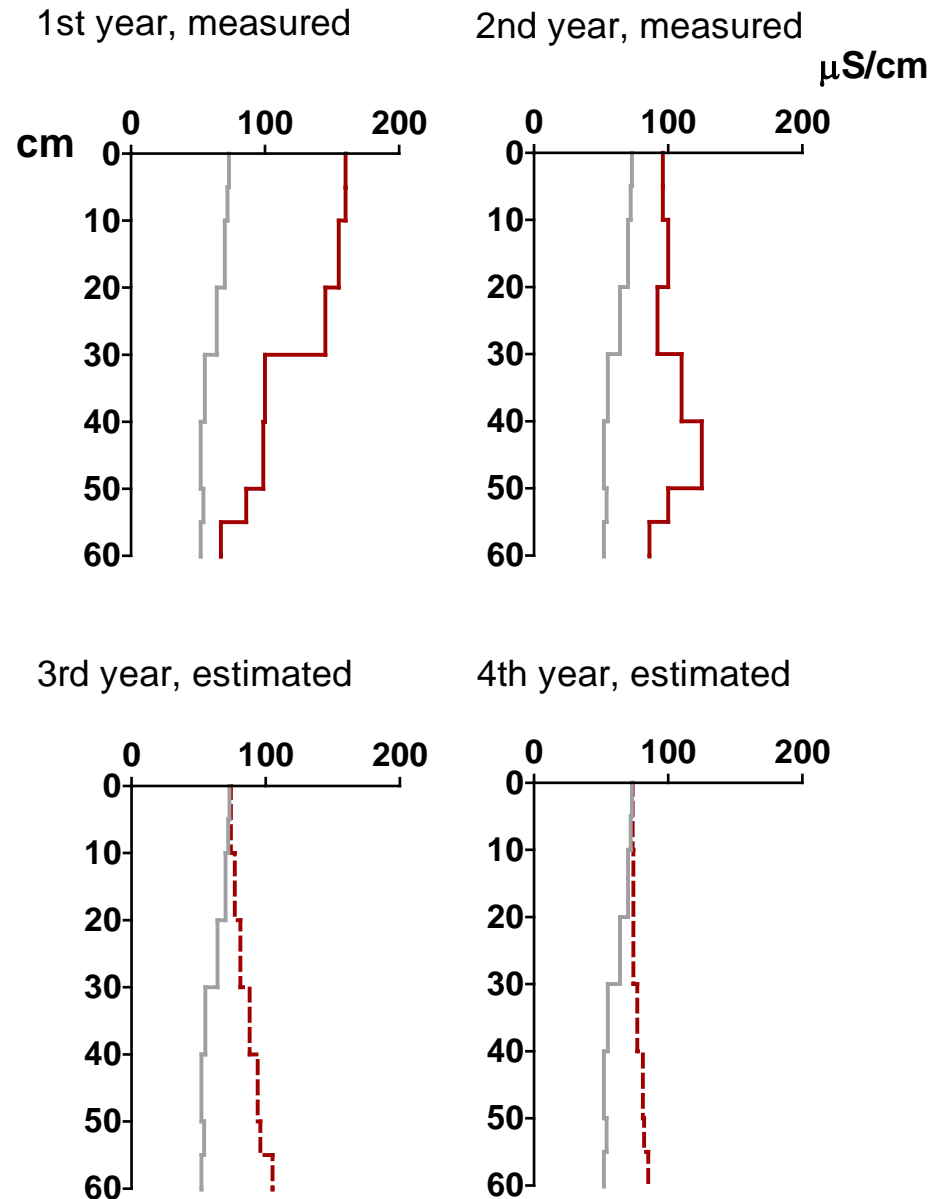
Concentrations of dissolved reactive P were about 50% lower in gypsum-amended soils in the both years of this study.



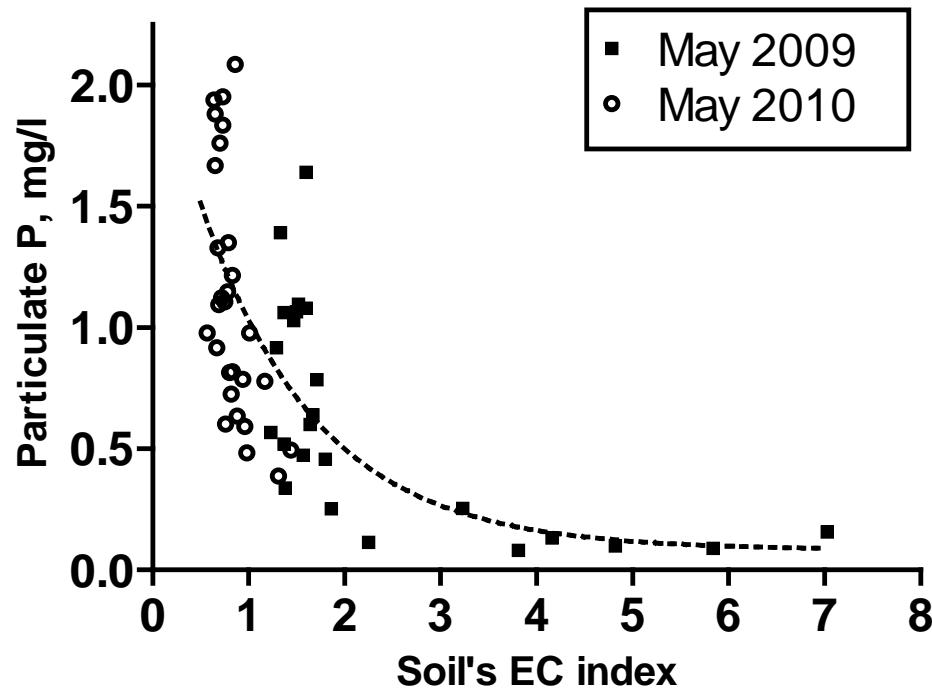
It was estimated that the salt pulse after gypsum application has leached out of the upper 50 cm layer in 4 years

Gypsum dissolves in percolating water and migrates down in the soil profile.

An estimate of the effective duration of a single gypsum application is 3-4 years.



The magnitude of gypsum effect and the need for reapplication may be assessed by monitoring electrical conductivity (EC) index of soils



EC index values higher than 2-3 ( $\times 10^4$  S/cm) indicate little soil dispersion and particulate P loss potential.

# The effects on yield quantity and quality

- No effect on the quantity of harvested yield
- No clear effect on the market quality of wheat (protein content, seed weight, volume weight)
- Selenium content in grass and wheat decreased by about 65% in the first crop year after gypsum application
- In the second crop year, selenium content of the plants growing on gypsum-amended soils was somewhat lower than in the control treatments. As gypsum leaches deeper in the soil, selenium uptake is anticipated to recover.