

Phosphorus in Field Crops Rotations of the Pampas of Argentina: soil Bray P, P balance evolution, and soil P fractions and role of particulate organic matter in P cycling

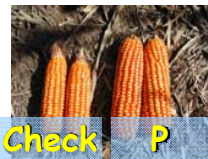
Ciampitti I.A.^{1,2}, F.O. García¹, G. Rubio² and L.I. Picone³

¹IPNI Latin American Southern Cone, Argentina. ²Facultad de Agronomía, UBA, Argentina. ³FCA-INTA Balcarce, Argentina.

iciampitti@ipni.net

OBJECTIVES

The objective of this work was to evaluate the effect of continuous phosphorus (P) fertilization on 1) P balance, 2) Bray P 1 dynamics, and 3) soil P inorganic and organic fractions, to improve the knowledge of soil P dynamics in two cropping systems: corn-double cropped wheat/soybeans (C-W/S; two sites), and corn-full season soybeans-double cropped wheat/soybeans (C-S-W/S; two sites) of the central Pampas of Argentina.

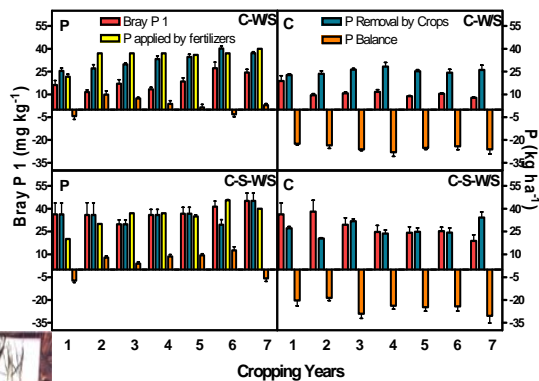


MATERIALS and METHODS

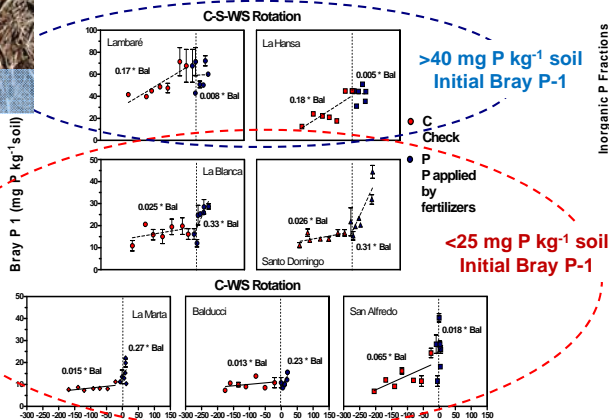
- ✦ The CREA long term network, on-farm fertilization experiments, was established in 2000.
- ✦ P balance, P addition by fertilizers minus P removal by grain, and dynamics of soil Bray P 1 were determined in seven soils, after seven years of continuous (P treatment) or no (C treatment) P application.
- ✦ Soil P was fractionated into Resin-Pi, NaHCO₃-Pi and Po, NaOH-Pi and Po, HCl-Pi, and Residue-P (Hedley et al., 1982). Determinations were made in four experimental sites of CREA South of Santa Fe Network Nutrition in the 2006/07 corn crop growing season.

RESULTS

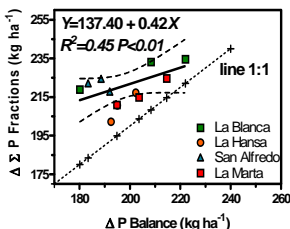
The C treatment presented a negative average P balance of 184.3 kg P ha⁻¹ and 183.1 kg P ha⁻¹ for all experimental sites of the C-S-W/S and C-W/S rotations, respectively. In the P treatment, the balances were positive: 39.1 kg P ha⁻¹ and 7.9 kg P ha⁻¹ for all experimental sites in the C-S-W/S and C-W/S rotations, respectively.



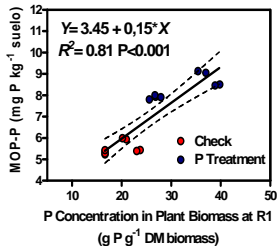
The figure above shows P balance, Removal by crops, P applied by inorganic fertilizers (kg P ha⁻¹) and extractable Bray P 1 (mg P kg⁻¹) along cropping years for both rotations: C-S-W/S and C-W/S. Each observation is an average of three replications for each experimental sites. Observation bars represent standard error media. At the end of seven years, the total amount of P applied by fertilizers was of 244 kg P ha⁻¹, in P plots. Letters C and P refer to check treatment and P treatment, respectively.



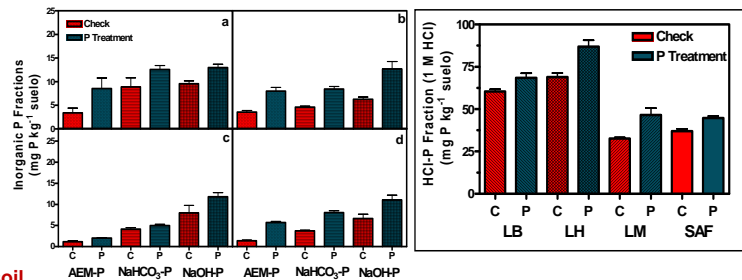
• In the accumulated P balance, the negative P budget of C treatments was similar between rotations because of an equivalent amount of P removal by crops. In P treatments, the difference in the positive budget between rotations is explained by a lower amount of P removal by C-S-W/S rotation because of less number of crops in seven years, than the intensified C-W/S productivity cropping system.
• Changes of fertilized and unfertilized treatments in the P accumulated balance and in Bray P 1 variables showed that it will be required 7.4 and 10.3 kg P ha⁻¹ for an increase of the extractable Bray P 1 level in 1 mg P kg⁻¹ for C-S-W/S and C-W/S, rotations respectively.



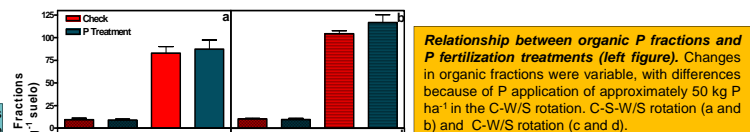
Changes in P balance and in all P Hedley fractions were calculated as the difference between C and P treatments (above). The fractionation was able to extract and account for all changes in soil P dynamics and evolution during seven years of P fertilization.



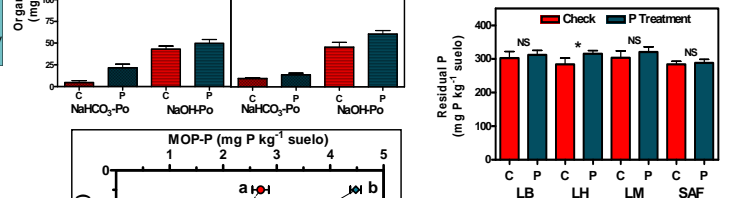
The figure above shows the relationship between MOP-P fraction and P concentration in corn crop at the flowering period (R1). DM= Dry Matter.



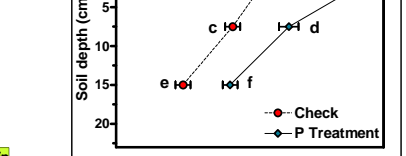
Relationship between inorganic P fractions and P fertilization treatments (above). AEM-P= Anion Exchange Membrane (AEM) P Fraction. In four experimental sites: (a) La Blanca, (b) La Hansa- C-S-W/S Rotation, (c) La Marta and (d) San Alfredo- C-W/S Rotation. All inorganic fractions were higher in P fertilized treatment than in C treatment. Moreover, this increase was relatively higher in the AEM-P fraction, relative term, and in the HCl-P in absolute values.



Relationship between organic P fractions and P fertilization treatments (left figure). Changes in organic fractions were variable, with differences because of P application of approximately 50 kg P ha⁻¹ in the C-W/S rotation, C-S-W/S rotation (a and b) and C-W/S rotation (c and d).



Relationship between residual P fraction and P fertilization treatments in the four experimental sites (above). Only the site La Hansa (LH), presented significant differences (*) between C and P treatments. NS= not significant differences.



The figure above shows the distribution of MOP-P fraction in soil horizons, as an average of four experimental sites. MOP-P fraction has increased under continuous P fertilization.

ACKNOWLEDGEMENTS

