

# Direct and Residual Effects of Balanced Fertilization in Field Crops of the Pampas of Argentina

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## Introduction

Field crop production in the Pampas region of Argentina is generally affected by nitrogen (N) and phosphorus (P) deficiencies. In recent years, sulfur (S) has also been reported as a limiting nutrient for field crops. In the CREA (Regional Consortium of Agricultural Experimentation) Region of Southern Santa Fe soybean, wheat and corn are cropped in two or three year rotations: corn-wheat/soybean (C-W/S), and corn-soybean-wheat/soybean (C-S-W/S).

Fertilization management focuses on the immediate crop but there is no information on its long-term effects.

## Objectives

- To determine direct and residual crop responses to the application of N, P, S, and other nutrients (potassium, magnesium, boron, copper, and zinc)
- To evaluate diagnostic methodologies for N, P, and S fertilization of corn, wheat and soybean
- To evaluate the effects of nutrient management on soil properties.

## Materials and Methods

✦ Eleven field experiments have been established in 2000/01 in farmer's fields of the CREA Region of Southern Santa Fe (southern Santa Fe and southern Cordoba provinces, Argentina): Five sites under corn-wheat/soybean (C-W/S) rotation, and six sites under corn-soybean-wheat/soybean (C-S-W/S) rotation. This paper presents the results of the first six years of the study

✦ Soils at the different sites are classified as Typic Argiudolls or Typic Hapludolls

✦ Fields were under continuous annual cropping for 50-60 years and under continuous no-tillage management for at least 5 years prior to 2000/01

✦ Fertilization treatments receive nutrient rates equivalent to nutrient removal by grain to keep the soil nutrient balance close to its original condition (Table 1), and are repeated every year on the same plots to evaluate direct and residual fertilization effects

✦ Treatments are set in randomized complete block design with three replications at each site.

Table 1. Nutrient rates applied annually in the six treatments.

Treatment	Check	PS	NS	NP	NPS	NPS Micros
	----- kg nutrients/ha -----					
N		10-20	90-175	90-175	90-175	90-175
P		20-46		20-46	20-46	20-46
K						0-18
Mg						0-13
S		19-25	19-25		19-25	19-25
B						1
Cu						2
Zn						2-4

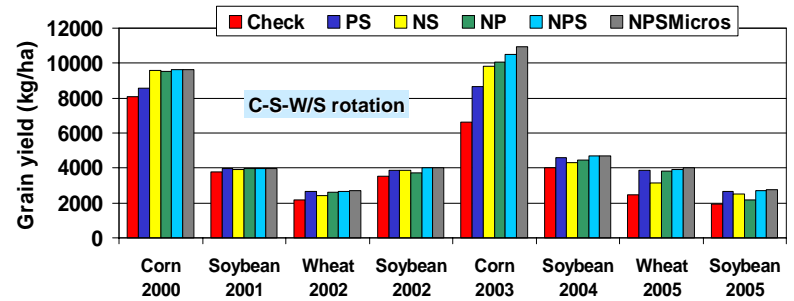
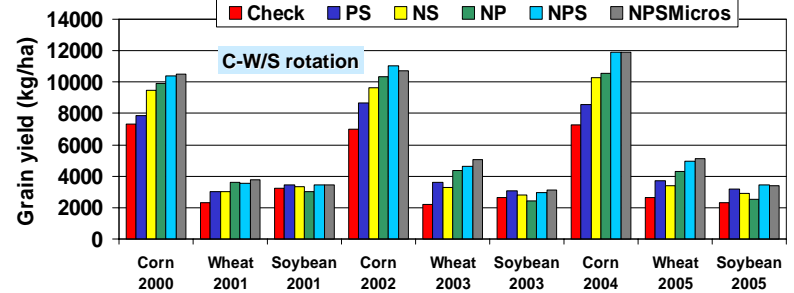
## Results

✦ For corn, in 23 site/years, responses were significant in 21, 8, 6, and 5 site/years for N, P, S, and NPS, respectively.

✦ For wheat, responses were significant in 10 of the 25 site/years for N, 19 site/years for P, 6 site/years for S, and 3 site/years for other nutrients.

✦ For double cropped soybean, responses were significant in 3 of the 25 site/years for N, 6 site/years for P, 17 site/years for S, and 8 site/years for NPS.

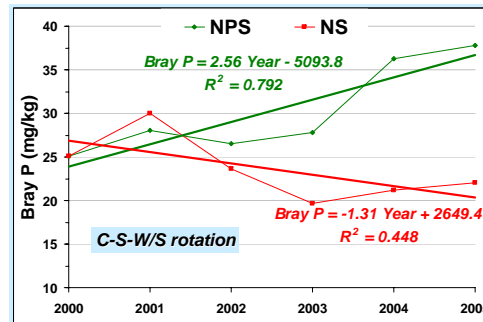
✦ For full season soybean, in 11 site/years, responses were significant in 1, 3, 2, and 3 site/years for N, P, S, and NPS, respectively.



✦ Frequency of responses and yield differences increased along the six seasons of evaluation as a consequence of residual effects that resulted in soil fertility buildup

✦ Nutrient use efficiencies (NUE, kg grain yield increase per kg of nutrient added) were 10.4-24.8, 0.1-10.2, and 0.1-2.0 kg grain kg<sup>-1</sup> N for corn, wheat, and double cropped soybean, respectively; 3.3-46.5, 6.5-36.2, 2.3-11.5, and 2.1-12.1 kg grain kg<sup>-1</sup> P for corn, wheat, full season soybean, and double cropped soybean; and 5.2-60.5, 2.8-28.3, 0-10.1, and 14.7-37.0 kg grain kg<sup>-1</sup> S for corn, wheat, full season soybean, and double cropped soybean

✦ High values of partial factor productivity (FPF, kg grain yield per kg of nutrient added) for N, 68-102 kg corn kg<sup>-1</sup> N, and 22-41 kg wheat kg<sup>-1</sup> N, indicate high N efficiency use compared to data reported in other cropping systems



✦ Depending on the rotation, average soil Bray 1 P increased by 2.1-2.6 mg/kg per year, in the NPS treatment and decreased by 0.2-1.3 mg/kg per year, in the NS treatments.

✦ Residual effects of N or S fertilization could not be detected in soil nitrate-N or sulfate-S analysis at planting.

✦ Comparison of soil organic carbon (SOC) concentrations between the Check and NPS treatments showed an average increase of 3.4 g C kg<sup>-1</sup> soil after four seasons, but these changes in SOC were highly variable among sites

✦ Fertilization with NPS generally tended to decrease soil pH, -0.4 to -0.1 units depending on the site

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