ABSTRACT: 221

BALANCE OF NITROGEN IN AGRICULTURAL SEQUENCES WITH PRESENCE OF SOYBEAN IN THE SOUTH OF ARGENTINE PAMPA

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The expansion of agriculture in the south of Argentine pampa in recent years has been associated with the increasing area occupied by soybean. Its presence is widespread, raising questions about the evolution of soil productivity and its impact on other crops, as many authors claim that biological fixation of nitrogen (BFN) itself is not sufficient to replace the nitrogen (N) taken out of the system.

We analyzed the impact produced by the presence of soybean on N balance in cropping sequences currently used in the region. A long term trial conducted on the Barrow Integrated Experimental Farm (38º19´25" S; 60º14´33" W) on a Petrocalcic Paleudoll soil under a no-tillage system, was used for evaluating a six year cycle. In the five treatments compared, the frequency of soybean varied between 1 and 5 years. The rest of the crops used in each sequence were fertilized with N, using 2 levels: current use fertilization dose (FUA) and replenishment fertilization dose (FR). The yields obtained were related to the protein content of grains to determine the export of N from each sequence. The dose of fertilizer used in each culture was related to the export of N produced, to make a balance in each of the sequences. In the case of soybean, a BNF of 50% was considered.

Environmental conditions occurred during the studied period (2004-2009) influenced the achievement of yields below the estimates when the N replacement was considered. Highly significant effects were observed in the sequence x fertilization interaction in all the treatments with two fertilization levels. A higher presence of soybean was associated with lower values on the balance of N. The number of years that soybean was planted was of singular importance in the sequence in relation to N balance for FUA. Its high requirement of N caused annual negative balances, even considering the BNF. When N rates increased (FR), the effect was reduced.

Based on the results obtained, the implementation of crop sequences that do not involve negative nutrient balances is proposed, provided a proper fertilization programme is used, the soybean crop is efficiently used in the rotation and adjusting the doses to the extraction levels produced, especially with those nutrients with more economic response, such as N. The inclusion of soybean sequences in the rotation must consider these premises in order to maintain a sustainable production system.

NITROGEN BALANCE IN AGRICULTURAL SEQUENCES WITH PRESENCE OF SOYBEAN IN THE SOUTH OF ARGENTINE PAMPAS

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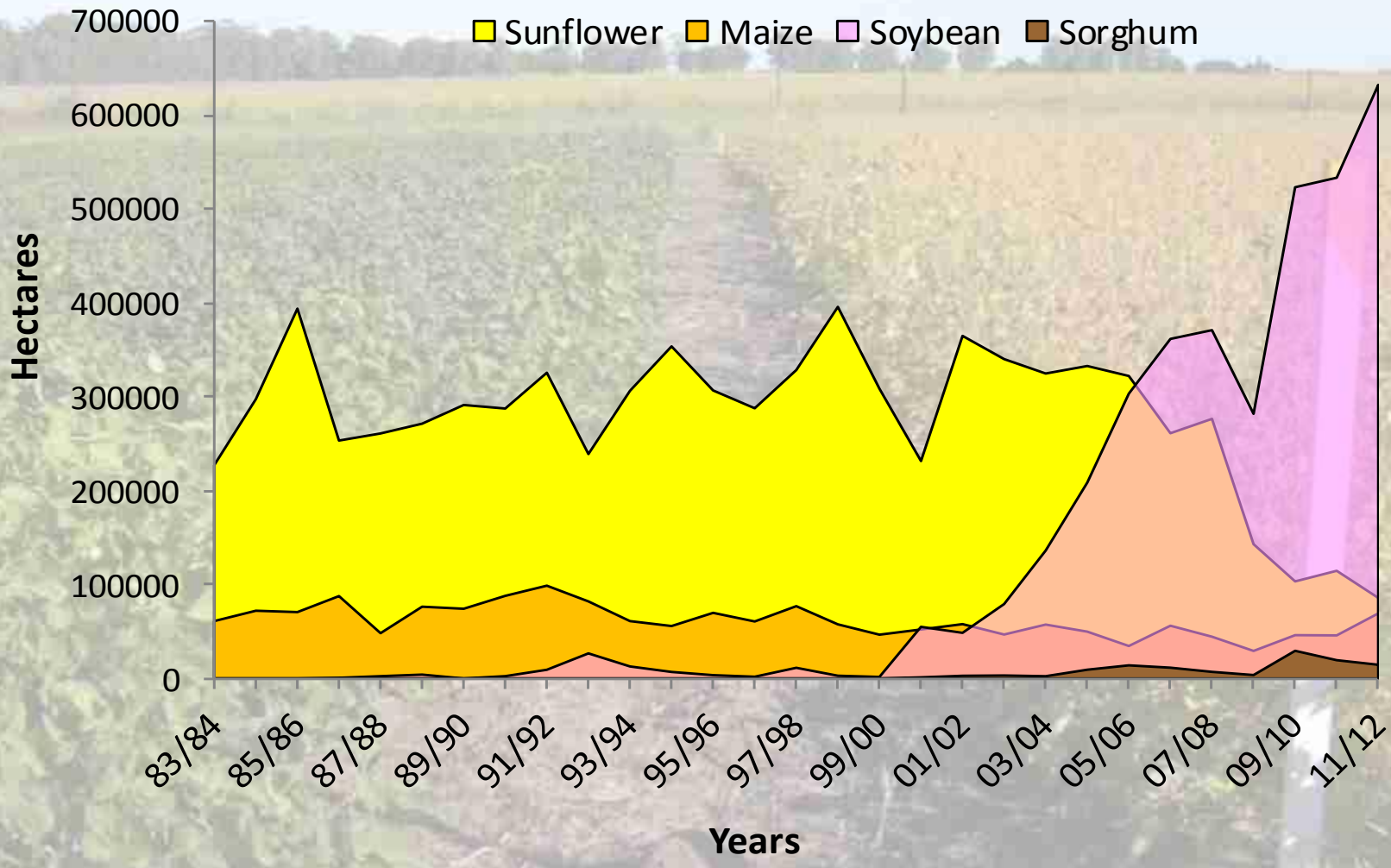
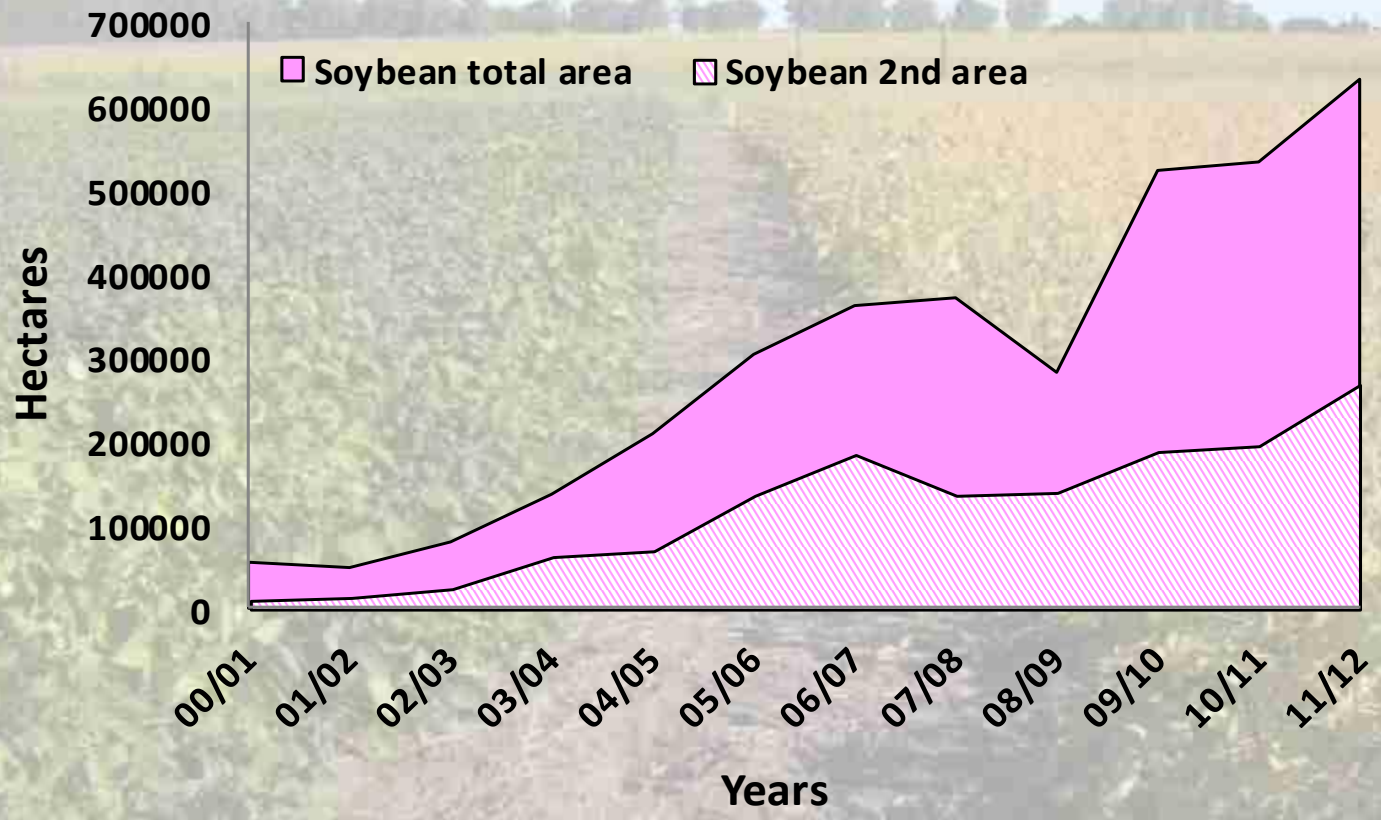
Ministerio de Agricultura, Ganadería y Pesca
Presidencia de la Nación

Location of study

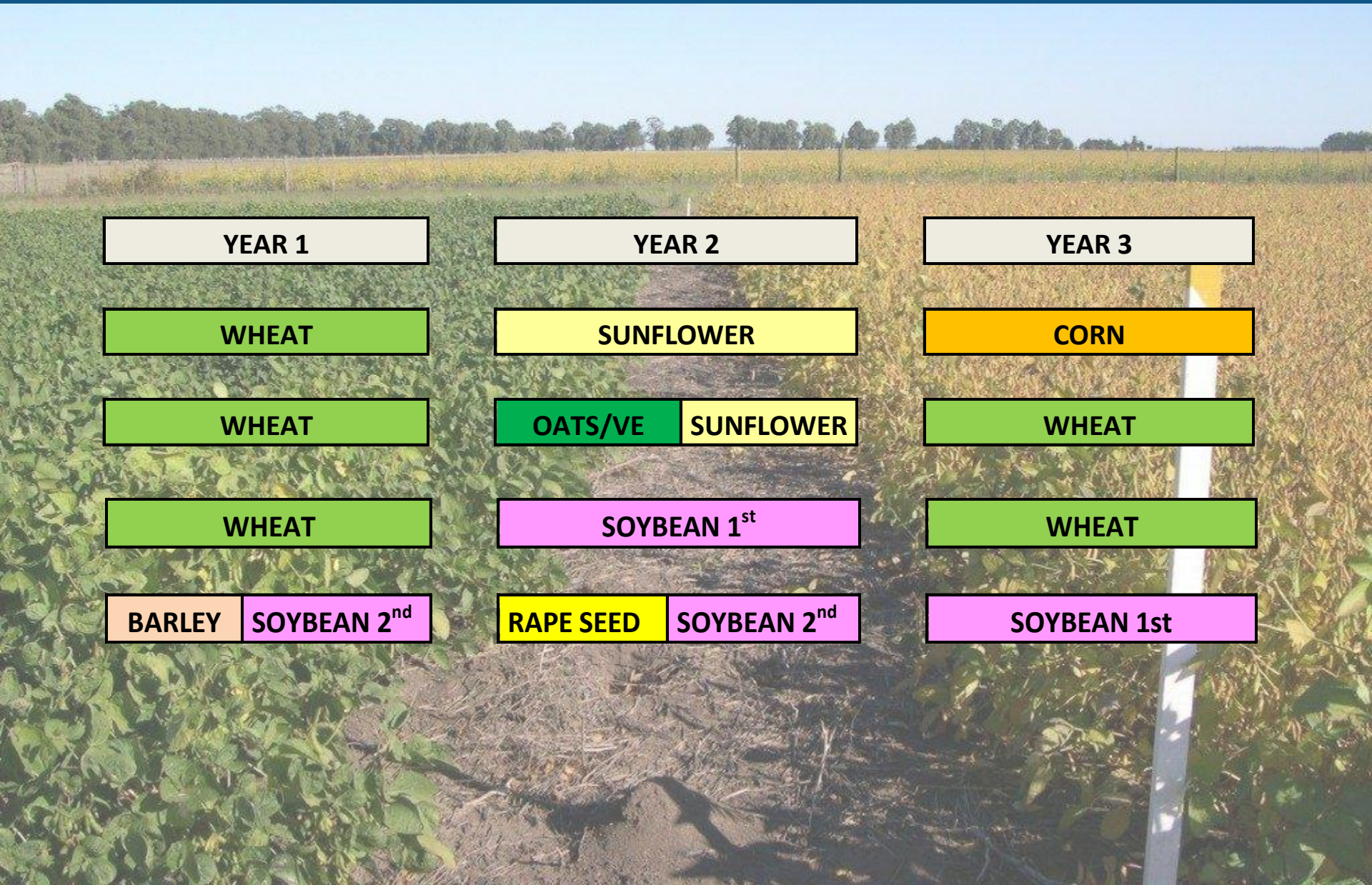
Summer harvest crops area



Soybean area (1st. and 2nd)



Crop sequences



YEAR 1	YEAR 2	YEAR 3
WHEAT	SUNFLOWER	CORN
WHEAT	OATS/VE / SUNFLOWER	WHEAT
WHEAT	SOYBEAN 1st	WHEAT
BARLEY / SOYBEAN 2nd	RAPE SEED / SOYBEAN 2nd	SOYBEAN 1st

Questions and Hypothesis

With the presence of soybean in the sequence:

- ***How will the N level and the soil productivity evolve?.***
- ***What will be the consequences for the remaining crops?***

Hypothesis:

The continued presence of soybean in the crop sequence, decreases the levels of soil nitrogen and produces greater dependence on fertilizers in the production system.

Objective

To evaluate the impact produced by the presence of soybean implanted at different intensities on nitrogen balance of crop sequences used in the region, considering two levels of nitrogen fertilization on the remaining components of the agricultural sequence

Materials and methods

- ✓ The study was carried out between 2004 and 2009 (6 years) in Barrow Integrated Experimental Station (38 20 'S - 60 13' W), under no tillage.
- ✓ Soil: Paleudoll petrocalcic
- ✓ Experimental design: Split-plot with four replications. Subplot = 210m ².
- ✓ The sequences used in the comparison, accounted for the most commonly used in the region in recent years, including soybeans with different intensities

Compared sequences

Sequence	2004	2005	2006	2007	2008	2009	Years with soybean
1	SUNFLOWER	WHEAT	SORGHUM	WHEAT	SOYBEAN 1st	WHEAT	1
2	SOYBEAN 1st	RAPESEED / SOYBEAN 2nd	WHEAT / SOYBEAN 2nd	SORGHUM	SOYBEAN 1st	WHEAT	4
3	RAPESEED / SOYBEAN 2nd	WHEAT	BARLEY / SOYBEAN 2nd	RAPESEED / SOYBEAN 2nd	BARLEY / SOYBEAN 2nd	WHEAT	4
4	OATS/VE / SUNFLOWER	WHEAT	OATS/VE / SUNFLOWER	WHEAT / SOYBEAN 2nd	OATS/VE / SOYBEAN 2nd	WHEAT	2
5	SOYBEAN 1st	BARLEY / SOYBEAN 2nd	RAPESEED / SOYBEAN 2nd	BARLEY / SOYBEAN 2nd	RAPESEED / SOYBEAN 2nd	WHEAT	5

Fertilization

CROPS	NITROGEN	
	CUF	RF
	.....kg.ha^{-1}.....	
Wheat	82	112
Barley	82	103
Sorghum	64	103
Rape seed	73	98
Sunflower	36	49
Soybean 1st	-	-
Soybean 2nd	-	-
Oats-Vetch	40	40

Calculating the balance

Yield x % Protein → **N export with grain**

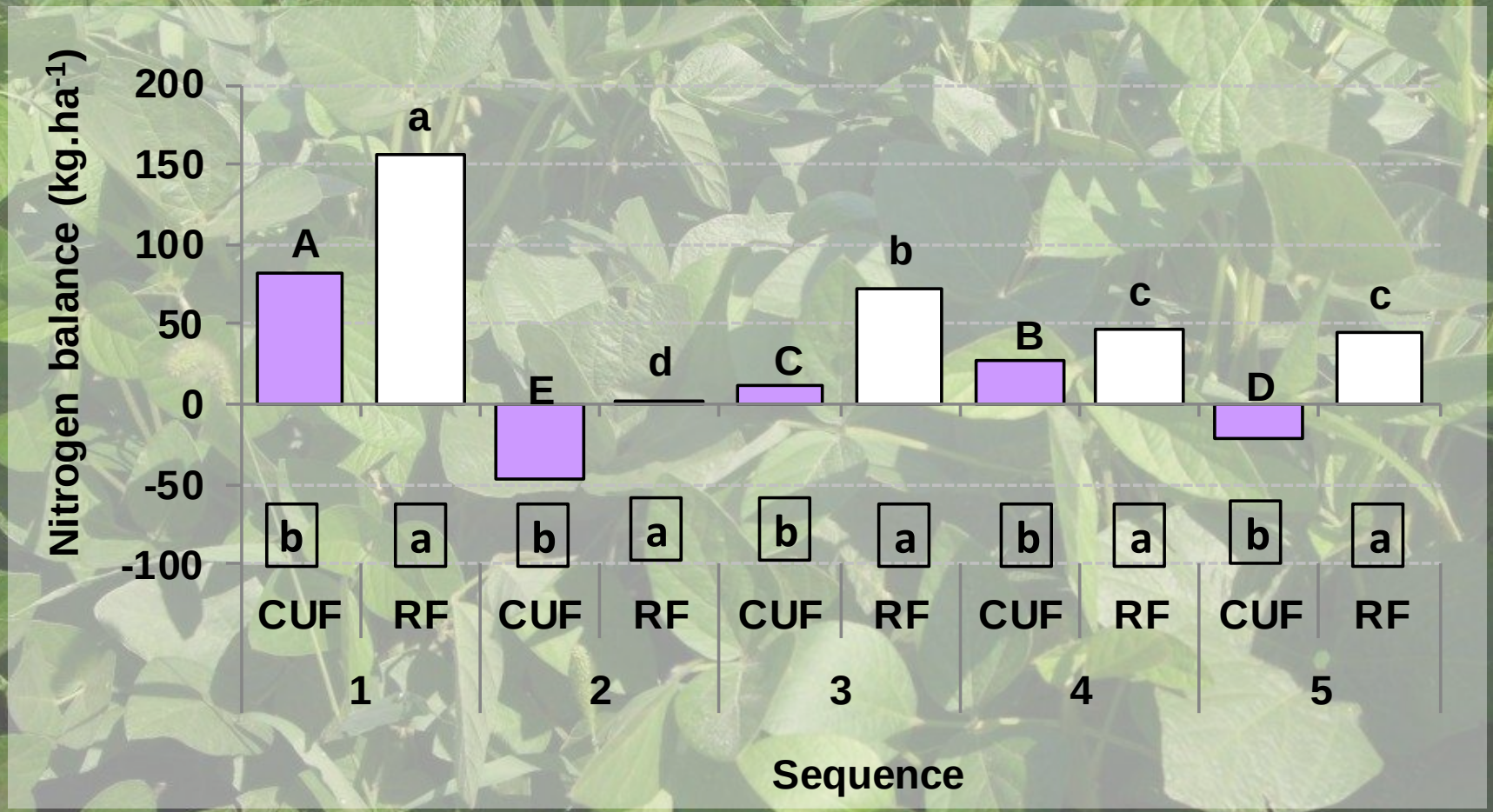
Fertilizer – N export → **N Balance**

RESULTS

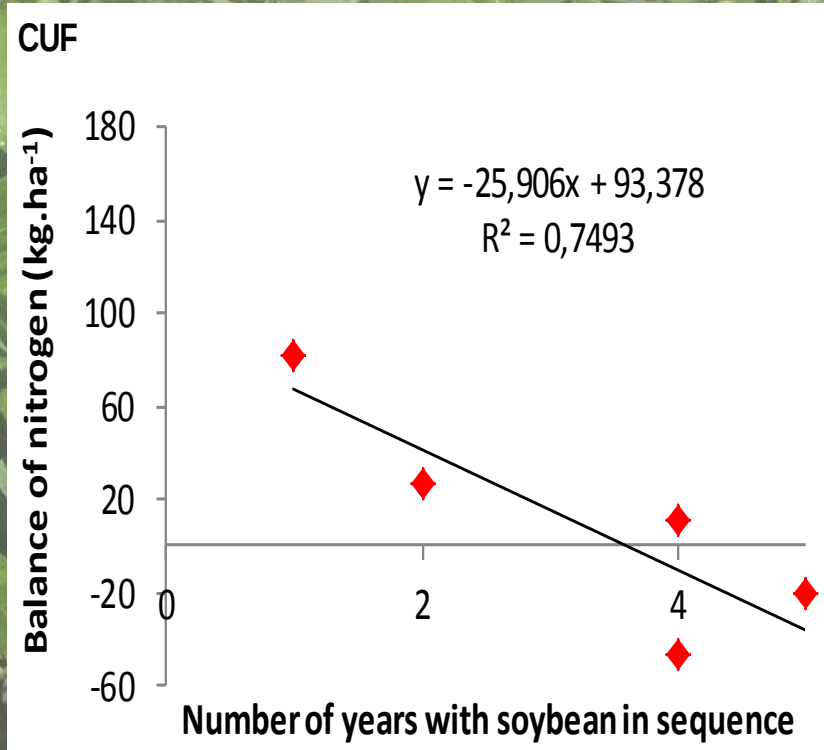
Crop yields and water balance

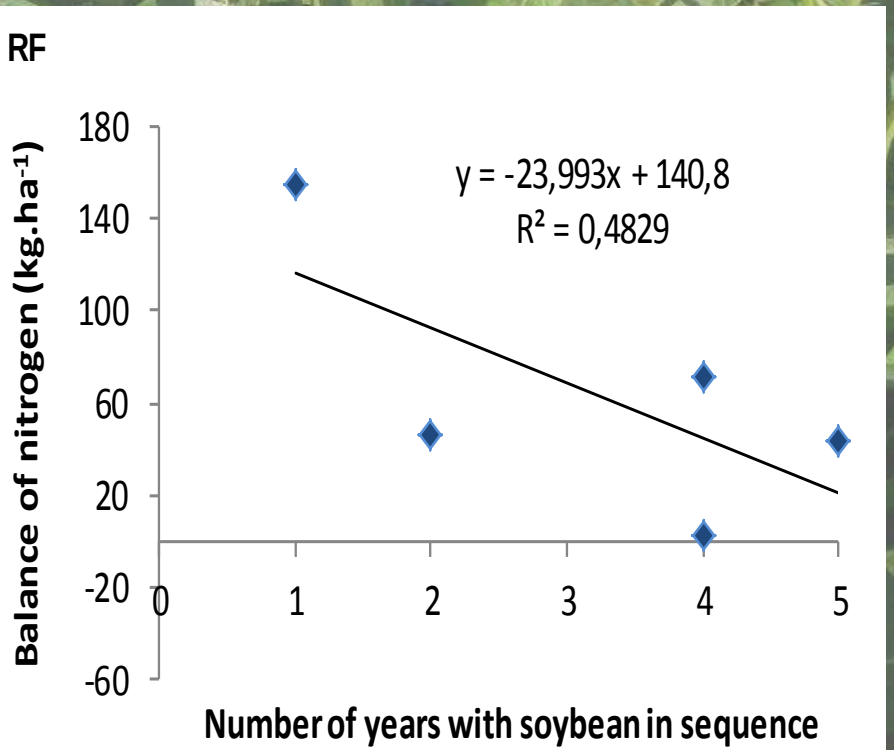
Sequence		2004		2005		2006		2007		2008		2009
1		SUNFLOWER		WHEAT		SORGHUM		WHEAT		SOYBEAN 1st		WHEAT
	Yield CUF	1660		2510		3315		945		1015		2560
	Yield RF	1750		2810		4580		1380		1240		2685
	Water balance	-169		-215		-188		-261		-360		-327
2		SOYBEAN 1st		RAPESEED	SOYBEAN 2nd	WHEAT	SOYBEAN 2nd	SORGHUM		SOYBEAN 1st		WHEAT
	Yield CUF	2470		1395	870	2310	1215	4380		1105		2505
	Yield RF	2470		1675	860	2835	1370	5115		1190		2855
	Water balance	-178		-222	-175	-133	-105	-277		-360		-327
3		RAPESEED	SOYBEAN 2nd	WHEAT		BARLEY	SOYBEAN 2nd	RAPESEED	SOYBEAN 2nd	BARLEY	SOYBEAN 2nd	WHEAT
	Yield CUF	1530	945	2570		5040	2740	1215	240	2555	545	2275
	Yield RF	1855	1125	3005		5380	2710	1540	275	2905	610	2575
	Water balance	-179	-100	-215		-186	-158	-248	-144	-303	-172	-327
4		OATS/VE	SUNFLOWER	WHEAT		OATS/VE	SUNFLOWER	WHEAT	SOYBEAN 2nd	OATS/VE	SOYBEAN 2nd	WHEAT
	Yield CUF	5270	1450	1840		3265	915	1650	110	6640	970	2415
	Yield RF	5270	1660	2400		4590	1110	2225	190	7280	1055	2505
	Water balance	-20	-169	-215		-130	-212	-261	-144	-17	-360	-327
5		SOYBEAN 1st		BARLEY	SOYBEAN 2nd	RAPESEED	SOYBEAN 2nd	BARLEY	SOYBEAN 2nd	RAPESEED	SOYBEAN 2nd	WHEAT
	Yield CUF	2945		3700	910	1010	2510	2375	230	850	605	2740
	Yield RF	2945		4250	1030	1300	2480	2510	315	1075	885	2785
	Water balance	-178		-139	-175	-270	-105	-182	-144	-371	-172	-327

Nitrogen balance



Soybeans in the sequence and nitrogen balance





Conclusions

- The weather conditions that occurred during the study period, influenced to produce lower yields than estimated when considering the replacement fertilization.
- The high N requirement of soybean, caused negative annual returns of that element when the crop was included in the first planting, even considering the Nitrogen Biological Fixation.
- When the soybean crop acted as second, with lower levels, the negative balance was compensate, in most cases, by the positive balance of the preceding crop.
- A greater presence of soybean in the agricultural sequence was associated with the lowest values achieved in N balance

Recommendations

Implementation of crops sequences that do not imply negative N balances.

The inclusion of soybean must consider an adequate programming of fertilization in the rotation, efficiently applied, and adapting the doses to the extraction levels produced.

The N balance turns to be a very useful tool for the purposes of diagramming fertilization strategies in the sequence and, principally, for preserving the N soil.