STARTER FERTILIZER OF VARYING GRADES AND RATES FOR NO-TILLAGE CORN IN ARGENTINA

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INTA - Exp.St. Pergamino and Mercedes

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Fluid fertilizers in Argentina

- The development of a fluid fertilizer industry has been growing steadily since its inception in 1996 (the 1st national-scale manufacturer)
- Recent challenges deals with NPS/NPSK clear solutions (mostly manufactured by small & medium firms) for early application (pre-plant, planting, post-emergence)
- To give the proper…
  - Timing
  - Placement
  - Rate

…for this new given source

Nitrogen and Phosphorus in starters

- N and P, alone or placed together are thought the major contributors.
- The challenge is to apply as much at sowing to cover replacement without waste and potential fitotoxicity:

Corn 10 mt ha^{-1} → 38 kg P ha^{-1}
48 kg K ha^{-1}
10 kg S ha^{-1}

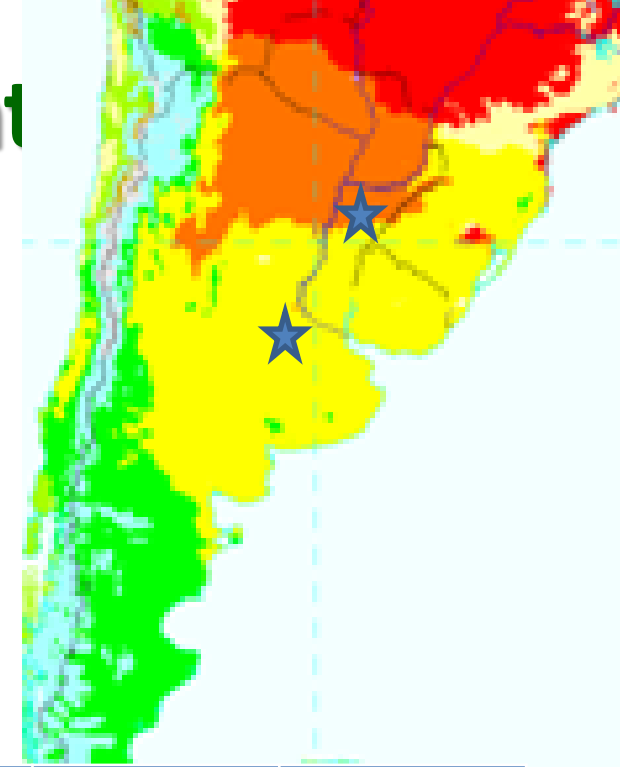
Heckman et al , 2003

Objective

To find out the best NPKS grades and rates as a starter for corn grain yield in two regions of Argentina

We aimed to get a simple blend proportion among common fluid sources that would be easily adopted by retailers and farmers

Experiments in two different environments



- **Pergamino** (Buenos Aires, 34°S). Thermic. Very High soil K – low S
- **Mercedes** (Corrientes, 29°S). Hyperthermic. Very Low soil K – low S

Location	*Texture top soil*	*pH*	*OM*	*P-Bray 1*	*S-SO_4*	*K*
			g kg^{-1}	..... *mg* kg^{-1}		
Pergamino	Loamy clay	5.7	37	14.6	7.8	486
2012-13		5.5	35	44.7	17.5	505
2013-14		5.5	20	3.8	6.0	367
Mercedes	Sandy loam	5.8	24	10.0	8.0	47
2012-13		5.5	18	10.7	4.9	55
2013-14		5.5	22	5.2	5.1	51

Pergamino

2011
2012
2013

- NK900, sown November 15-2011, 7.5 pl m^2
- Arvales 2310 MG, sown December 15 -2012, 7.6 pl m^2
- DK192, sown October 24-2013, 7.0 pl m^2

Mercedes

.

2011
2012
2013

- DK390 HX RR, sown December 22-2011, 6.1 pl m^2
- M510 HX RR2, sown August 30-2012, 7.9 pl m^2
- DK190, sown September 20-2013, 6.6 pl m^2

Materials and Methods

Treatment Factors:

- Contrast: Granular vs. Fluid
- Varying P:N ratios: + S in Pergamino
  1:1 & 2:1 APP-ATS
  + K in Mercedes
  1:1:1 & 1:2:1 UAN-APP-ATK
- Rates of product:
- 120 & 180 kg/ha - Pergamino
  150 & 250 kg/ha – Mercedes

Fluid materials used to prepare the mixes

Product	N	P_2O_5	K_2O	S	SG - Density
	g/g				kg/lt
APP	0.11	0.37			1.42
TSA	0.12			0.26	1.32
TSK			0.25	0.17	1.46
UAN	0.32				1.32

Granular sources used to prepare the mixes

	Pergamino	
N:P ratio	N:P = 1:1	N:P 1:2
DAP	51%	72%
SSP	49%	28%

	Mercedes	
N:P:K ratio	1:1:1	1:2:1
DAP	9%	35%
CLK	21%	15%
SSP	70%	50%

Fertilizer treatments - Pergamino

Treatments	Starter		Nutrients w/starter			Urea			N:P ratios	
	Ratio TSA:APP	Rate	N	P	S	Sowing	at V-6	N Total	P:N	S:N
			kg/ha							
Check	-	0	-	-	-	36	312	160		
Granular A	-	65	3	**18**	**6**	33	309	160	**1.0**	**0.2**
Fluid 1	1:1	120	22	**22**	**7**	-	298	160	**1.0**	**0.2**
Fluid 2	1:1	180	33	**33**	**11**	-	273	160	**1.0**	**0.2**
Granular B	-	75	7	**26**	**4**	21	306	160	**1.5**	**0.1**
Fluid 1	1:2	120	19	**29**	**5**	-	306	160	**1.5**	**0.1**
Fluid 2	1:2	180	29	**44**	**4**	-	285	160	**1.5**	**0.1**

N-Urea was applied at V-6 to compensate the supply from starters and equal N rate.

A check without PK or PS was included with the same rate of N

N-urea in granular treatments at sowing was applied casted over the row

Fertilizer treatments - Pergamino

NP Rates

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Fertilizer treatments - Mercedes

N:P ratios

Treatments	Starter		Nutrients w/starter				Urea			Ratios	
	Ratio UAN:APP :TSK	Rate	N	P	K	S	Sowing	at V-6	N Total	P:N	K:N
			kg/ha								
Check	-	0	**0**	**0**	**0**	**0**	**43**	**218**	**120**		
Granular A	-	100	**2**	**18**	**12**	**8**	**43**	**215**	**120**	**0.9**	**0.6**
Fluid 1	1:1:1	150	**21**	**18**	**12**	**8**	**0**	**215**	**120**	**0.9**	**0.6**
Fluid 2	1:1:1	250	**35**	**31**	**21**	**14**	**29**	**184**	**120**	**0.9**	**0.6**
Granular B	-	110	**7**	**29**	**10**	**7**	**0**	**217**	**120**	**1.4**	**0.5**
Fluid 1	1:2:1	150	**20**	**28**	**9**	**6**	**0**	**217**	**120**	**1.4**	**0.5**
Fluid 2	1:2:1	250	34	46	16	11	0	**188**	**120**	**1.4**	**0.5**

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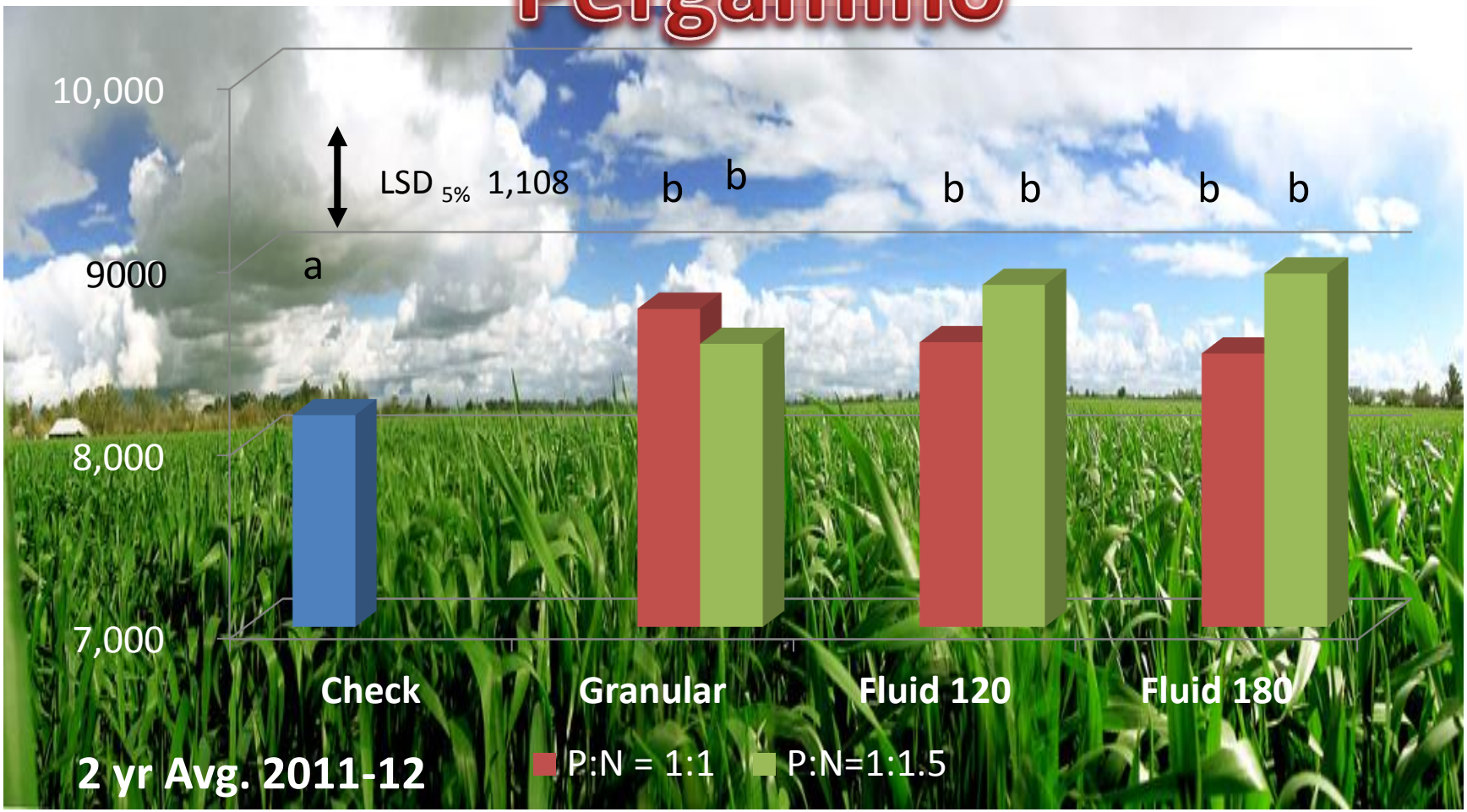
Results & Discussion

Pergamino



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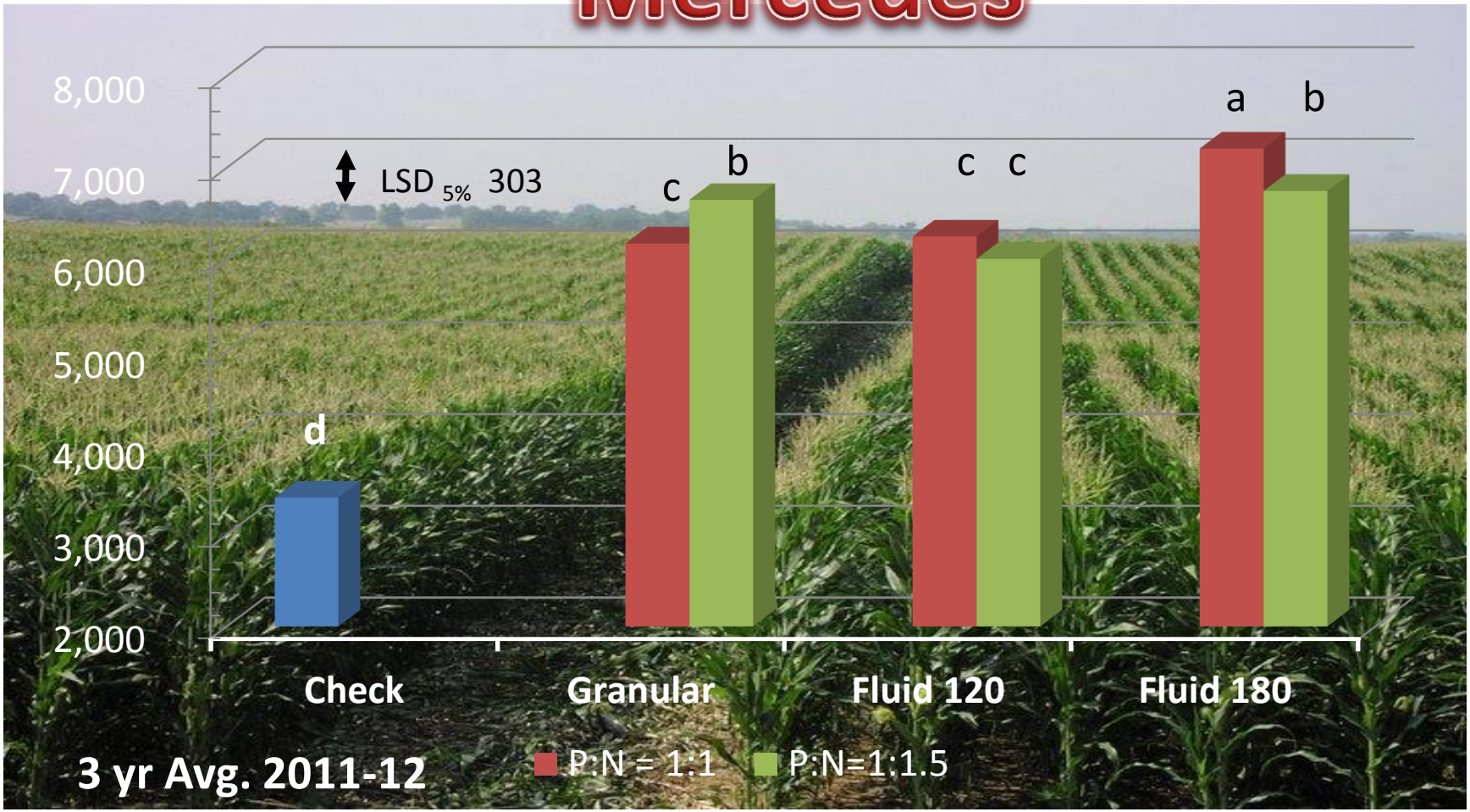
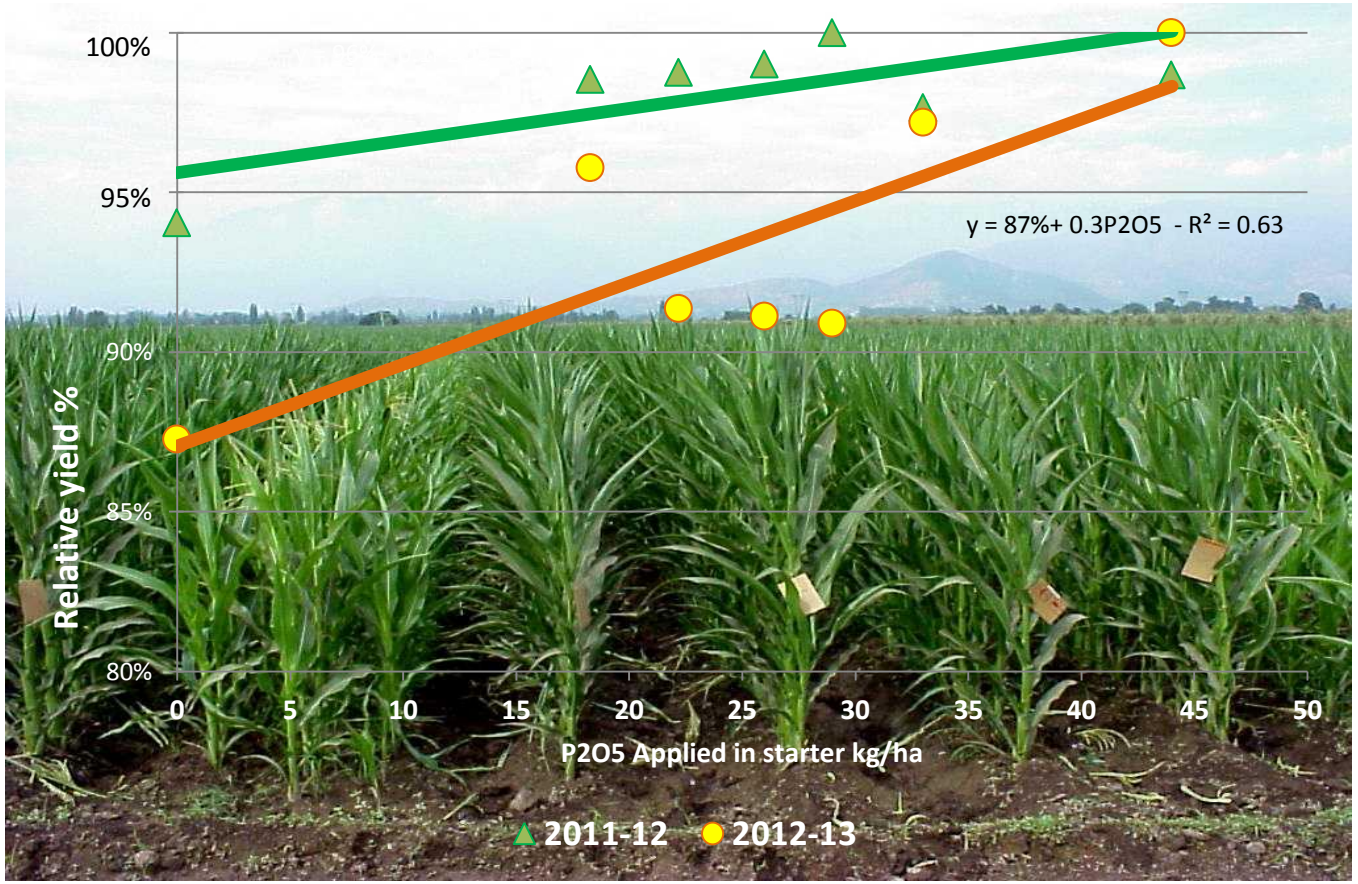


Statistics

	Mercedes			Pergamino	
	2011-12	2012-13	2013-14	2011-12	2012-13
			Pr > F		
Treat vs Control	<.0001 **	<.0001	<.0001 **	0.076	0.46 ns
Granular vs. Fluid	0.0004 **	0.33 ns	0.32 ns	0.72 ns	0.85 ns
Rate	<.0001 **	0.47 ns	<.0001 **	0.47 ns	0.42 ns
P:N ratio	<.0001 **	0.38 ns	0.102#	0.52 ns	0.91 ns
Rate* P:N ratio	0.88 ns	0.15 ns	0.93 ns	0.96 ns	0.73 ns
LSD 5%	643	597	421	471	2263
CV %	6.7	6.9	4.8	3.5	18.6

Pergamino – Very high K

In high P fertility soils the response to P is low, regardless N:P ratio, fertilizer form or P rate



Soil P Bray 1: 15-44 ppm

Pergamino – Very high K

The same is observed on S response, low since requirement is low relative to the supply

Available S-SO4 : 8 - 18 ppm

Pergamino – Very high K

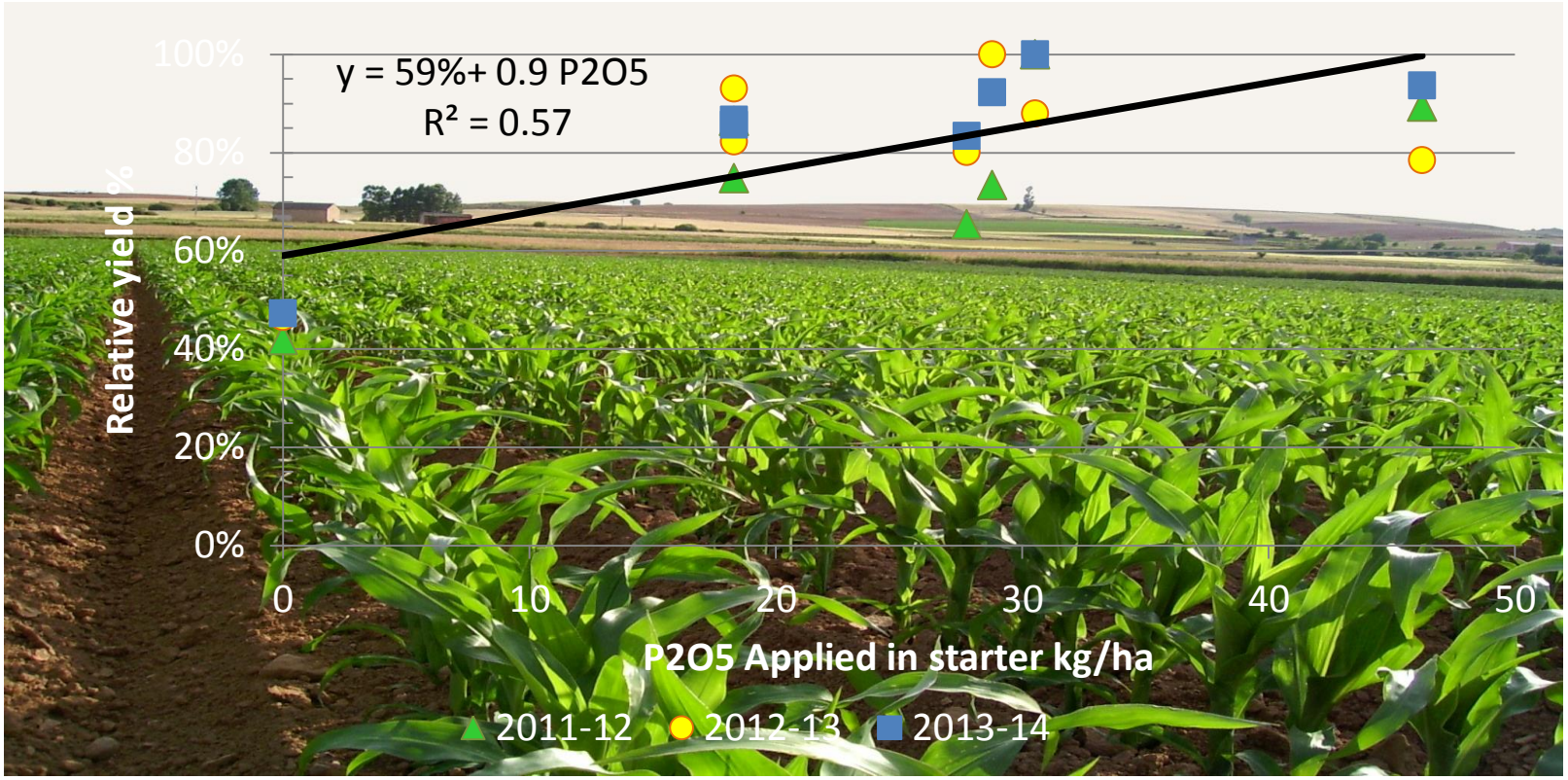
Several rates & NPS ratio appears suitable, given the lack of difference among the RY, the cost of the nutrients and the closest balance

Pergamino	Applied	Removal kg ha^{-1}		Relative yield	P	S
Treatments	Kg P –S ha^{-1}	P	S	%	Use/Removal ratio	
Granular A	18 – 6	33	8.7	91%	53%	65%
Fluid 1	22 – 7	33	8.6	97%	69%	85%
Fluid 2	33 – 11	32	8.5	95%	104%	128%
Granular B	26 - 4	33	8.5	94%	79%	49%
Fluid 1	29 – 5	34	8.9	95%	87%	54%
Fluid 2	44 - 7	34	8.9	99%	130%	80%

(*) Average of the 2 years

Mercedes – Very Low K

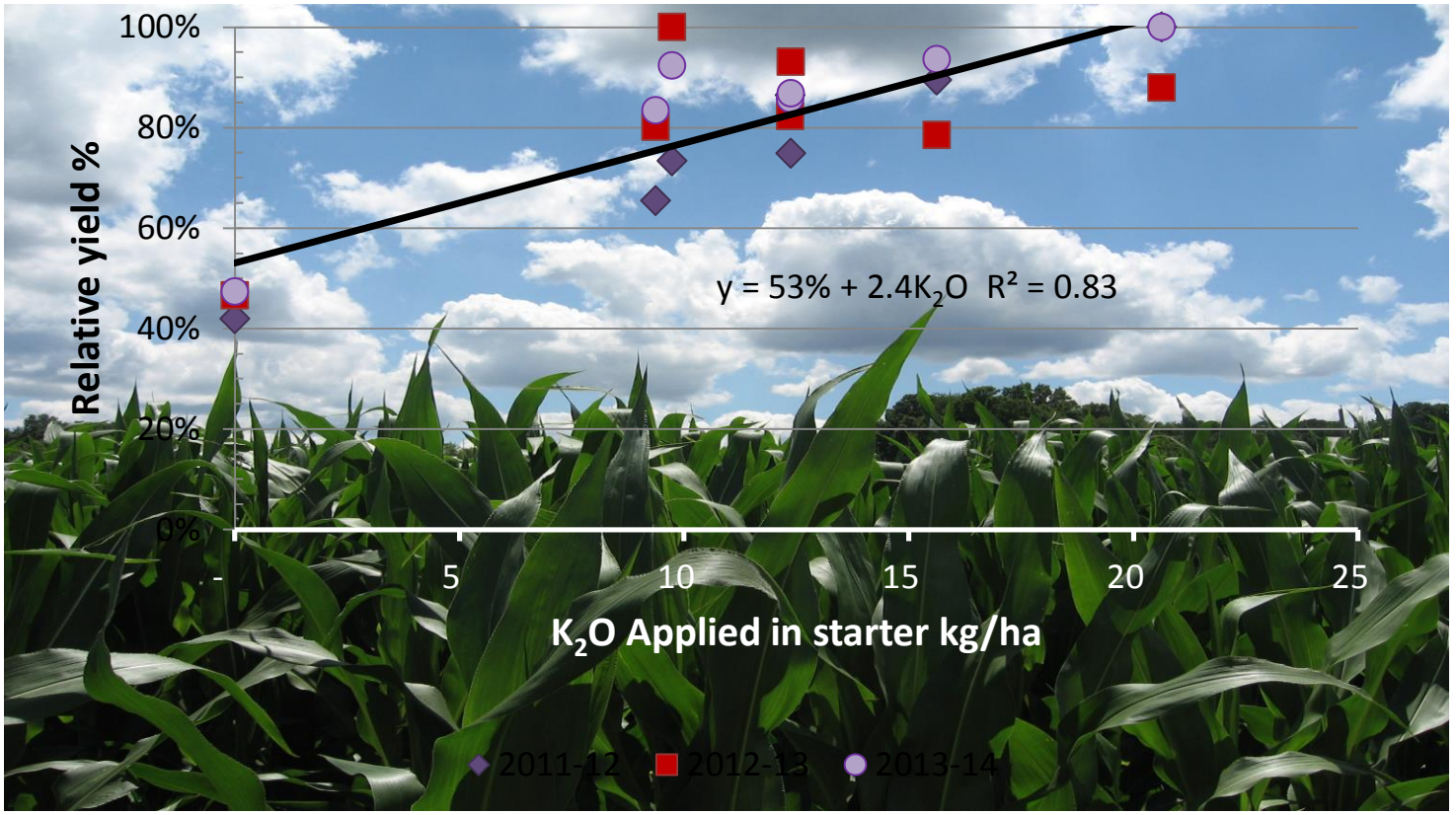
N:P ratio or the rate of the starter means a definite P rate in low P soils, regardless N ratio or fertilizer form



Soil P Bray 1 : 5 - 10 ppm

Mercedes – Very Low K

On the other hand, response to K seems linear, therefore starter response is response to K



Soil exchangeable K : 47-55 ppm

Mercedes – Very Low K

That rate & NPK ratio seems the best, given the highest RY, the highest K supply and the closest balance

Treatments	Applied	Removal kg ha^{-1}		Relative yield	P	K
	Kg P –K ha^{-1}	P	K	%	Use/Removal ratio (*)	
Granular A	18-12	25	32	85%	79%	42%
Fluid 1	18-12	25	31	85%	77%	41%
Fluid 2	31-21	28	36	96%	113%	60%
Granular B	29-10	26	32	89%	114%	30%
Fluid 1	28-9	22	27	76%	122%	33%
Fluid 2	46-10	25	32	87%	183%	48%

(*) Average of the 3 years

Conclusions

- There was response to fertilization in four of the five experiments.
- Fluid was not different to granular at same nutrient rate and P:N ratio in all trials.
- The P:N ratio 1:1 performed better than 1:1.5 in Mercedes (need less N). In Pergamino was reverse (need more N) regardless the rate.
- The rate effect was significant only in Mercedes.

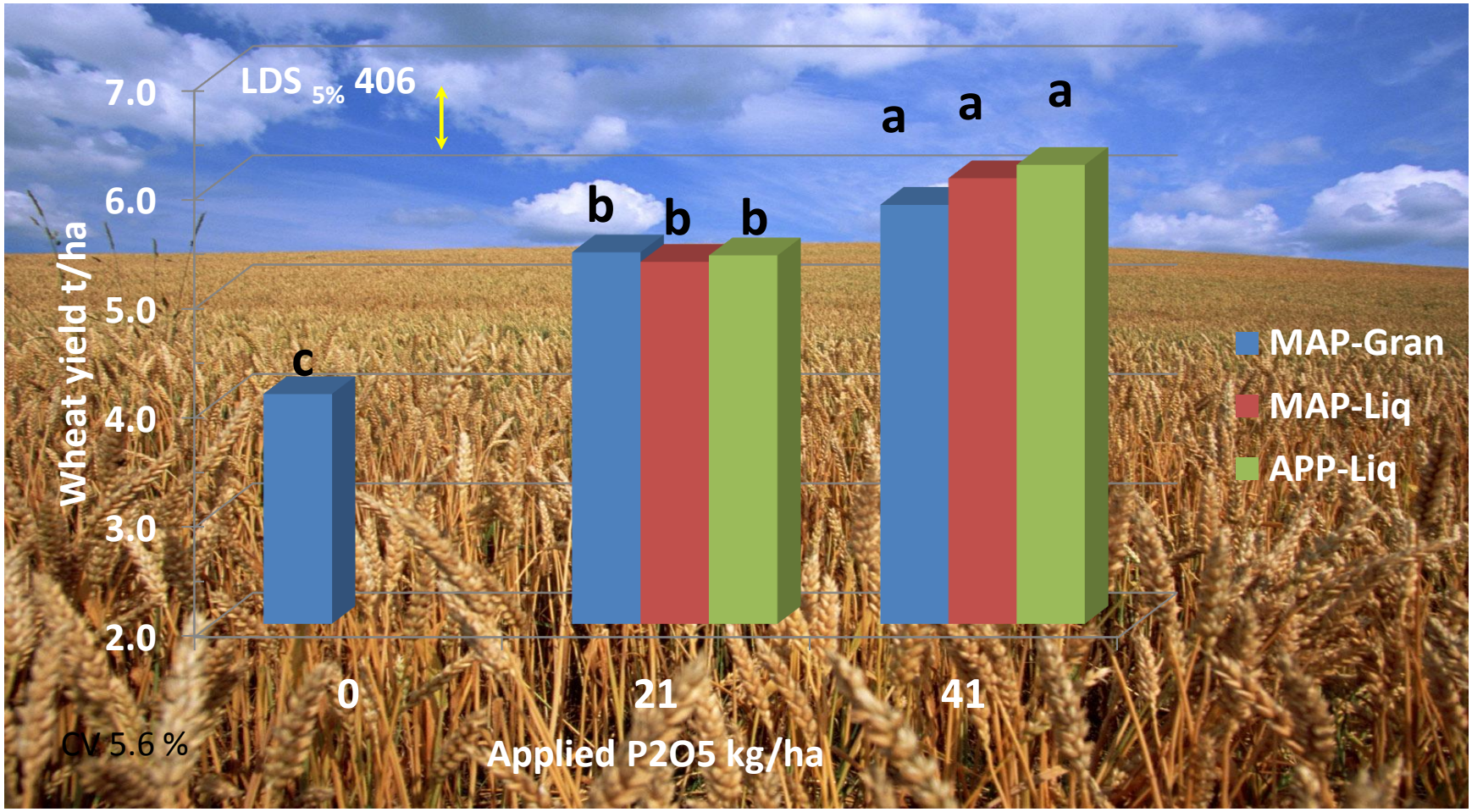
Conclusions

- There is always a concern on how starters affect plant stand, but in none of the trials was observed any reduction in stand
- The effect of starter on early growth were observed along the whole growth cycle in all trials, and resulted in grain yield differences (check vs. others)
- All evaluated grades were able to supply enough P or S to achieve a reasonable replacement percentage (application vs. removal), but not K

Additional trial comparing P sources as starter

- Location: 9 de Julio (Buenos Aires).
- Wheat – cv. Baguette 802. Sown June 25, 2013.
- Soil
  - Sandy Clay Loam, pH 5.7, O.M. 2.8 %, P-Bray 12 ppm, K 678 ppm, S-SO4 10 ppm
- Seven (7) Treatments:
  - 2 rates: 21 & 41 kg P_2O_5/ha + Check (no P)
  - 3 sources: 1 granular (MAP) and 2 fluids (APP & AOP)
- Design:
  - Randomized Block with 4 reps.
- N management.
  - N was equaled in 20 kg N/ha on all treatments at sowing.
  - At Feeks 3.2 stage, 60 kg/ha was broadcast as UAN on the site.
- Weed and Pest management.
  - Usual chemical treatment

Results



- No difference in grain yields among P sources
- Significant response to P on grain yields and TW, regardless the source

u very much for your attention !

collaborators …

Gabriel Kuriger
Enrique Figueroa
Diego Saba

Fluid Fertilizer Foundation

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