



Ammonium-N Improve the Phosphorus Use Efficiency of Plants

Elialdo Alves Souza, Ciro Antonio Rosolem, Moniki Campos Janegitz, Stefany Sofia Alves Campanati and Aline Silva Sandim



São Paulo State University, College of Agricultural Sciences, C.P.237, Botucatu,
AL 18603-970, Brazil ,email: eli_agronomo@yahoo.com.br

INTRODUCTION

Strategies to improve P use efficiency need consider the plant-rhizosphere-soil system and the practices of fertilization. The N forms used on the soil affect rhizosphere processes, development of the root system and the P uptake differently. The use of N-ammonium by plants spends less energy and increases work of symporters $H^+/H_2PO_4^-$, but N-nitrate is the predominant form in most situations.

OBJECTIVE

The aim of this work is to study the impact of different N sources (ammonium-N, nitric-N and both) on dry matter production and P use efficiency by maize.

MATERIALS AND METHODS

15 treatments: three N fertilizers (calcium nitrate, ammonium sulfate and both) were combined with five P doses (0, 40, 80, 120 and 160 mg kg⁻¹) like triple superphosphate . N dose applied: 240 mg kg⁻¹ → 4 replicates → CRD

Greenhouse → **Pots of 12 L** → 2 plants for pot (*Zea mays* L.) → One month after emergence (Dec 11 2013) the soils were collected

Plant samples:

Separation of shoots and roots → Samples were oven-dried at 65°C for 72 h

Analysis :

P (Malavolta et al., 1997) and dry matter → Calculation of efficiencies (Roberts, 2008) →

RESULTS

Table 1: Total, root and shoot dry matter

Total Dry Matter (g)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
0	2.75 a	1.70 a	1.91 a
40	29.05 a	28.85 a	13.55 b
80	39.26 a	39.52 a	41.60 a
120	50.00 b	56.82 a	55.15 ab
160	64.00 b	77.47 a	76.91 a
ED	Q**	L**	L**
CV (%)	10.24		
Root Dry Matter (g)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
0	1.15 a	0.55 a	0.59 a
40	9.87 a	7.70 b	3.57 c
80	12.52 a	7.57 b	7.10 b
120	19.77 a	7.77 c	12.55 b
160	16.75 a	9.72 c	12.19 b
ED	Q**	Q**	Q**
CV (%)	11.97		
Root Dry Matter (g)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
0	1.60 a	1.25 a	1.31 a
40	19.17 a	21.15 a	9.97 b
80	26.73 b	31.95 ab	34.50 a
120	35.37 b	42.22 a	44.27 a
160	47.50 b	67.75 a	64.62 a
ED	L**	L**	L**
CV (%)	13.16		

Letters on the lines denote significant difference by Tukey Test (p<0,05). ED (Effect of Doses) by regression: L (linear); Q (quadratic); NS (not significant); * (p<0,05); ** (p<0,01).

Table 2: Datas of efficiencies.

P Uptake Efficiency (%)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
40	4.00 a	3.32 b	1.26 c
80	3.34 a	2.90 b	2.82 b
120	2.78 a	2.88 a	2.97 a
160	2.52 c	5.47 a	3.77 b
ED	Q**	Q**	Q**
CV (%)	7.93		
P Physiological Efficiency (%)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
40	1.37 c	1.71 b	1.92 a
80	1.31 b	1.38 b	1.47 a
120	1.31 a	1.16 b	1.29 a
160	1.17 a	0.74 c	1.01 b
ED	Q**	Q**	Q**
CV (%)	8.61		
P Use Efficiency (%)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
40	5.48 a	5.65 a	2.42 b
80	3.80 a	3.94 a	4.13 a
120	3.64 ab	3.35 b	3.81 a
160	2.94 b	4.02 a	3.83 a
ED	Q**	Q**	Q**
CV (%)	9.83		

Letters on the lines denote significant difference by Tukey Test (p<0,05). ED (Effect of Doses) by regression: L (linear); Q (quadratic); NS (not significant); * (p<0,05); ** (p<0,01).

Table 3: P in plant tissues and relation root/shoot.

P Concentration (g kg ⁻¹)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
0	0.48 a	0.48 a	0.47 a
40	0.71 a	0.58 b	0.51 c
80	0.74 b	0.86 a	0.67 c
120	0.75 b	0.85 a	0.77 b
160	0.84 c	1.34 a	0.97 b
ED	Q**	Q**	Q**
CV (%)	5.93		
P Accumulation (g kg ⁻¹)			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
0	1.31 a	0.81 a	0.89 a
40	20.50 a	16.93 a	6.93 b
80	29.15 ab	32.84 a	27.95 b
120	41.30 a	42.29 a	43.61 a
160	49.62 c	105.93 a	73.22 b
ED	Q**	Q**	Q**
CV (%)	7.45		
Relation Root/Shoot			
Doses of P (mg kg ⁻¹)	Form of N		
	NITRATE	AMMONIUM	NITRATE/AMMONIUM
0	0.71 a	0.35 c	0.46 b
40	0.51 a	0.36 b	0.36 b
80	0.47 a	0.21 b	0.24 b
120	0.55 a	0.18 c	0.28 b
160	0.37 a	0.15 b	0.19 b
ED	L**	L**	Q**
CV (%)	12.54		

Letters on the lines denote significant difference by Tukey Test (p<0,05). ED (Effect of Doses) by regression: L (linear); Q (quadratic); NS (not significant); * (p<0,05); ** (p<0,01).

CONCLUSIONS

N-ammonium is the best fertilizer to increase dry matter production and P uptake in rich patches of P.

N-ammonium guarantee the best nutrient use efficiency in all conditions of P availability.

In the lower levels of P it is capable to increase physiological efficiency and in the higher levels of P it is capable to increase uptake efficiency.