

**Comparison of Resin, Mehlich-1 and
Mehlich-3 extractants for phosphorus,
in Coastal Tableland soils**



ISSN 1678-1961

Outubro, 2009

Empresa Brasileira de Pesquisa Agropecuária
Centro de Pesquisa Agropecuária dos Tabuleiros Costeiros
Ministério da Agricultura, Pecuária e Abastecimento

Boletim de Pesquisa e Desenvolvimento 44

Comparison of Resin, Mehlich-1 and Mehlich-3 extractants for phosphorus, in Coastal Tableland soils

Lafayette Franco Sobral

Aracaju, SE
2009

Disponível em: <http://www.cpatc.embrapa.br/index.php?idpagina=fixas&pagina=publicacoesonline>

Embrapa Tabuleiros Costeiros

Av. Beira Mar, 3250, Aracaju, SE, CEP 49025-040

Caixa Postal 44

Fone: (79) 4009-1344

Fax: (79) 4009-1399

www.cpatc.embrapa.br

sac@cpatc.embrapa.br

Comitê Local de Publicações

Presidente: Ronaldo Souza Resende

Secretária-Executiva: Raquel Fernandes de Araújo Rodrigues

Membros: Semíramis Rabelo Ramalho Ramos, Julio Roberto Araujo de Amorim, Ana da Silva Lédo, Flávia Karine Nunes Pithan, Ana Veruska Cruz da Silva Muniz, Hymerson Costa Azevedo.

Supervisora editorial: Raquel Fernandes de Araújo Rodrigues

Revisão Bibliográfica: Josete Cunha Melo

Tratamento de ilustrações: Sandra Helena dos Santos

Editoração eletrônica: Sandra Helena dos Santos

Foto da capa: Lafayette Franco Sobral

1ª edição

Todos os direitos reservados.

A reprodução não-autorizada desta publicação, no todo ou em parte, constitui violação dos direitos autorais (Lei no 9.610).

Dados Internacionais de Catalogação na Publicação (CIP)

Embrapa Tabuleiros Costeiros

Sobral, Lafayette Franco

Comparison of resin, Mehlich-1 and Mehlich-w extractants for phosphorus, in coastal tableland / Lafayette Franco Sobral. -- Aracaju : Embrapa Coastal Tableland, 2009.

12 p. - (Research Development Bulletin / Embrapa Coastal Tableland, ISSN1678-1961; 44).

Access: <http://www.cpatc.embrapa.br/index.php?idpagina=fixas&pagina=publicacoesonline>

1. Soils. 2. Chemical analysis. 3. Coastal Tableland. I. Title. II. Series.

CDD 631.4

Sumário

Abstract	5
Resumo	7
Introduction	8
Materials and Methods	8
Results and Discussion	9
Conclusions	10
References	12

Comparison of Resin, Mehlich-1 and Mehlich-3 extractants for phosphorus, in Coastal Tableland soils

Lafayette Franco Sobral

Abstract

Assessment of P availability by Mehlich-1, currently used in the coastal tableland, was compared with that of the Mehlich-3 and resin. Twenty soil samples (0-20 cm depth) were collected from representative Oxisols, Ultisols and Spodosols in five States throughout the coastal tableland region. In order to evaluate P uptake by corn, an experiment was carried out in the greenhouse with 20 soils, and three replications. Correlation coefficients between corn P uptake and P extracted by Mehlich-1, Mehlich-3 and resin at corn harvest, were 0.61 e 0.56 e 0.72 for all soils and 0.85, 0.81 and 0.87 for soils with P lower than 40 mg dm⁻³. Comparisons between data obtained with Mehlich-1, Mehlich-3 and resin extractants, suggest that the Mehlich-1 is reliable for assessing soil P in the coastal tablelands soils.

Index terms: Soil fertility, soil testing, methods,

Comparação entre a resina, Mehlich-1 e Mehlich-3, para fósforo, em solos dos tabuleiros costeiros

Resumo

Resumo: Nos solos dos tabuleiros costeiros, a análise de P é feita pelo extrator Mehlich-1, o qual foi comparado, à resina e ao Mehlich-3. Vinte amostras de solo foram coletadas na profundidade 0-20 cm em cinco Estados do Nordeste do Brasil em perfis descritos de Latossolos, Argissolos e Espodosolos, os quais são os mais representativos dos tabuleiros costeiros. Para obter a absorção de fósforo pelo milho, foi conduzido um experimento em casa de vegetação com vinte solos e três repetições. Os coeficientes de correlação entre o P absorvido pelo milho e o P extraído pelo Mehlich-1, Mehlich-3 e resina após o cultivo do milho foram 0,61 e 0,56 e 0,72 para todos os solos e 0,85, 0,81 e 0,87 para os solos com P menor que 40 mg dm^{-3} . Os dados comparativos entre os extratores Mehlich-1, Mehlich-3 e o método da resina, sugerem que o Mehlich-1 é um extrator adequado para os solos dos tabuleiros costeiros.

Termos para indexação: Fertilidade do solo, análise de solo, métodos.

Introduction

Oxisols, Ultisols, Spodosols, and Entisols are the predominant soils in the Brazilian coastal tableland. These soils have low CEC and kaolinite is the primary clay mineral. Soil laboratories in the region extract P with the Mehlich-1. The resin procedure (Raij et al., 1986) and the Mehlich-3 (Mehlich, 1984) are potential alternatives to the Mehlich-1. The Mehlich-1 solution is a mixture of two acids which extracts portions of complexed and strongly adsorbed nutrients through a dissolution process. In the Mehlich-3 solution (Mehlich, 1984) the acetic acid buffers the solutions to a pH 2,5 and the nitric acid dissolves calcium phosphates. In addition, the ammonium fluoride extracts P related to iron and aluminum. Miranda et al. (2002) observed that Mehlich-1, Mehlich-3 and resin correlated well and both solutions showed a good prediction of available P in cerrado soils. The amount of P extracted was in the following order: resin > Mehlich-3 > Mehlich-1. Mylavarapu et al., (2002) obtained good correlation coefficients between Mehlich-1 and Mehlich-3 and the Mehlich-3 extracted more P than the Mehlich-1. The resin method is based on anion and cation exchange. Raij et al., (1986, 2001) improved this technique decreasing the time of analysis, making it feasible for routine work. Bissani et al. (2002) concluded that the resin removed more P than the Mehlich-1 and the difference was greater in soils with more than 400 g kg⁻¹ of clay content

The objective of this investigation was to compare soil phosphorus extractions with the Mehlich-1, the resin and the Mehlich-3 methods, in soils from the Brazilian Coastal Tablelands.

Materials and Methods

Twenty soil samples (0-20 cm depth), were collected from representative Ultisols, Oxisols and Spodosols in the Brazilian coastal tablelands, where soil profiles had been described. Soil organic matter, clay content, and pH in water were determined according with procedures described in Silva (1999) . Mehlich-

1-, Mehlich-3- and resin-extractable P contents were determined according with Silva (1999), Mehlich (1984) and Raij et al., (1986), respectively.

In order to evaluate P uptake by corn, an experiment was carried out in the greenhouse with 20 soils, and three replications. Each pot contained 2 L of soil, limed with Ca(OH)_2 based on its aluminum content, with a lime factor of 2 and, subsequently, incubated moist for 30 days. Final pH values in water ranged from 4.1 to 6.2 among the 20 soils. Eight corn seeds were sown to each pot. All pots received weekly additions of 0.1 L of a nutrient solution containing KNO_3 , $\text{Ca(NO}_3)_2$, MgSO_4 , H_3BO_3 , MnCl_2 , ZnSO_4 , CuSO_4 and H_2MoO_4 . Pots were weighed daily and water was added to approximate water holding capacity, previously estimated as water retained at 0.10 atm tension. After 40 days, aboveground plant material was harvested, dried digested with a mixture of perchloric and nitric acids and analyzed for P. Soils were removed from the pots, mixed, and soil phosphorus analyses were accomplished with the Mehlich-1 (Silva, 1999), the Mehlich-3 (Mehlich-1984), and the resin procedure according to Raij et al. (1986). Analysis of variance and regressions were performed with the Statistical Analysis System software (SAS, 1994).

Results and Discussion

Correlation coefficients between P uptake by corn and P extracted by Mehlich-1, Mehlich-3 and resin at corn harvest for all samples were 0,61 e 0,56 e 0,72 respectively and samples with P higher than 40 mg dm^{-3} , moved away from the regression line. As phosphorus content in the great majority of soil samples in coastal tableland soils is lower than 40 mg dm^{-3} , correlation coefficients were also calculated for samples with P Mehlich-1 lower than 40 mg dm^{-3} and they increased to 0,85, 0,81 e 0,87 for Mehlich-1, Mehlich-3 and resin respectively (Figure 1). Even though the mechanisms of P removal are different for the three methods and according to Raij et al. (2001) the resin is less influenced by clay content than the Mehlich-1, correlation coefficients between P uptake and P extracted by them are close. At the sampling depth of (0–20 cm) coastal tableland soils are low in clay content and kaolinite is the predominant clay mineral, making them alike. The correlation coefficients between P uptake and

Mehlich-1, Mehlich-3 and resin after adding soil attributes such pH, Al^{+3} , soil organic matter and clay contents into the regression model for all soils, were 0,74, 0,71 and 0,78 for the Mehlich-1, the Mehlich-3 and the resin respectively. Therefore, addition of these soil properties as explanatory variables did not contribute to improve the correlation coefficients between P uptake and P extracted by the three methods.

Conclusions

1. Correlation coefficients between corn P uptake and P extracted by Mehlich-1, Mehlich-3 and resin at corn harvest, were 0.61 e 0.56 e 0.72 for all soils and 0,85, 0,81 and 0,87 for soils with P lower than 40 mg dm^{-3} .
2. Comparisons between data obtained with Mehlich-1, Mehlich-3 and resin extractants, suggest that the Mehlich-1 is reliable for assessing soil P in the coastal tablelands soils.

Table 1. Range, means and standard deviations for initial values of pH, clay and organic matter and P by Mehlich-1 of the twenty 20 soil samples.

	Range		Mean	Standard Deviation
	Minimum	Maximum		
pH in water	4.1	5.9	5.1	0.5
Organic matter, g kg ⁻¹	12.1	75.9	42.4	18.0
Clay, g kg ⁻¹	10.0	272.6	120.5	79.4
P Mehlich-1, mg dm ⁻³	2.3	120.9	28.7	36.1

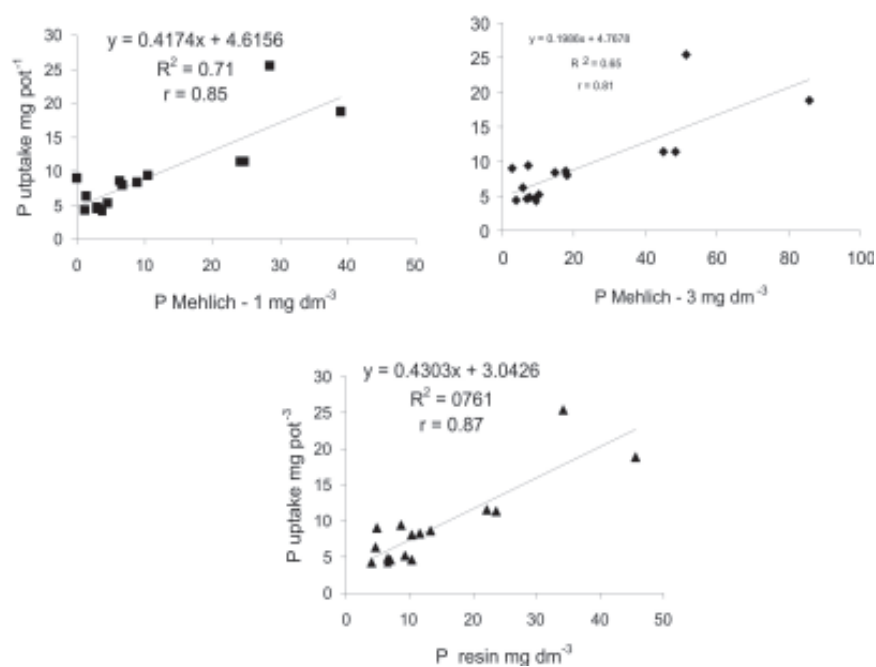


Figure 1. Linear regressions and correlation coefficients between P by Mehlich-1, Mehlich-3 and resin and P uptake by corn, for samples with P Mehlich – 1 lower than 40 mg dm⁻³.

References

BISSANI, C. A.; TEDESCO, M.J.; CAMARGO, F.A DE °; MIOLA, G.L.; GIANELLO, C. Anion-exchange resins and iron oxide-impregnated filter paper as plant available phosphorus indicators in soils. **Commun. Soil Sci. Plant Anal.**, v.33, n.7-8, p.1119-1130, 2002.

MIRANDA, L. N. de; AZEVEDO J. A. de; MIRANDA J. C. C de; GOMES A. C. Calibração de métodos de análise de fósforo e resposta do feijão ao fósforo no sulco. **Pesquisa Agropecuária Brasileira**, v. 37, n.11, p.1621-1627, 2002.

MYLAVARAPU, R. S.; SANCHEZ, J. F.; NGUYEN, J.H.; BARTOS, J. M. Evaluation of Mehlich-1 and Mehlich-3 extraction procedures for plant nutrients in acid minerals soils of Florida. **Commun. Soil Sci. Plant Anal.**, v.33, n.5-6, p. 807-820, 2002.

MEHLICH, A. Mehlich-3 soil test extractant: a modification of the Mehlich 2 extractant. **Commun. Soil Sci. Plant Anal.**, v. 15, n.12, p.1409-1416, 1984.

RAIJ, B. van ; QUAGGIO, J. A.; SILVA, N. M da. Extraction of phosphorus, potassium, calcium and magnesium from soils by ion-exchange resin procedure. **Commun. Soil Sci. Plant Anal.**, v.17, n.5, p. 547-566, 1986.

RAIJ, B. van; ANDRADE, J. C. de; CANTARELLA, H.; QUAGGIO, J. A. **Análise química para avaliação da fertilidade de solos tropicais**. Campinas: Instituto Agrônômico, 2001. 285 p.

SILVA, F. C. da. (Org). **Manual de análises químicas de solos, plantas e fertilizantes**. Brasília, DF, Embrapa Comunicação para Transferência de Tecnologia.,1999, 370 p.

STATISTICAL ANALYSIS SYSTEM. **User's Guide, v. 2**. Cary, NC., SAS Institute, Inc., 1994.



Coastal Tablelands

Ministry of
Agriculture,
and Supply

