

New possibilities for modelling dissolved P losses from agricultural areas

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Introduction

Background:

In Germany calcium acetate lactate extraction (PCAL) is commonly used to estimate plant available phosphorus in soils. However, PCAL cannot directly be used to estimate potential dissolved P losses from agricultural areas.

Degree of phosphorus saturation:

The degree of phosphorus saturation (DPS) of soils is a worldwide accepted parameter to estimate the risk of P losses and is closely correlated to WSP (Pöthig et al. 2010) resulting in a soil type independent function: $DPS=100/(1+1.25 \cdot WSP^{-0.75})$.

Methods

- Application of PCAL extraction to 53 soils from Brandenburg and Bavaria (sandy-, loamy-, calcareous- and decomposed peat soils) according to VDLUFA (2002), reducing agent changed: $NH_2OH \cdot HCl$ and $SnCl_2$ (Fischer et al. 2015)
- WSP extraction and conversion from WSP to DPS according to Pöthig et al. (2010)
- Existing PCAL data from agricultural soils was gathered from German authorities (see citations), P data from extraction with double lactate was transformed into PCAL data by correlations published by Schick et al. (2013)
- Inclusion of existing PCAL data by applying PCAL-WSP and WSP-DPS correlations to create a DPS map

Results

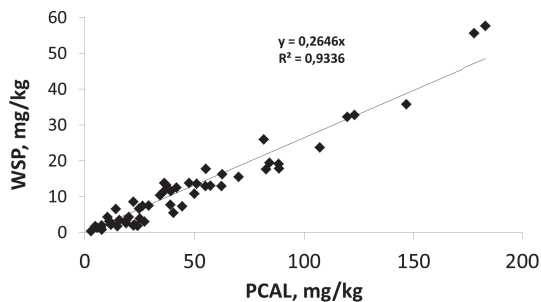


Fig.1 Correlation between PCAL and WSP for investigated soils

1) PCAL-WSP correlation (Fig.1):

- Independent of soil types our analyses resulted in two linear functions with different gradients for soils without and with $CaCO_3$, the latter caused by shifts in the pH values of the CAL extraction solutions (not shown)
- A conversion factor of 1.7027 for soils containing $CaCO_3$ allowed the application of one regression to all soils (Fig.1)

2) Application of DPS approach (Fig.2):

- DPS shows a high spatial variability mostly varying between 80% and 95% saturation
- Soils with DPS values higher than 80% (Pöthig et al. 2010) have a high risk of dissolved P losses

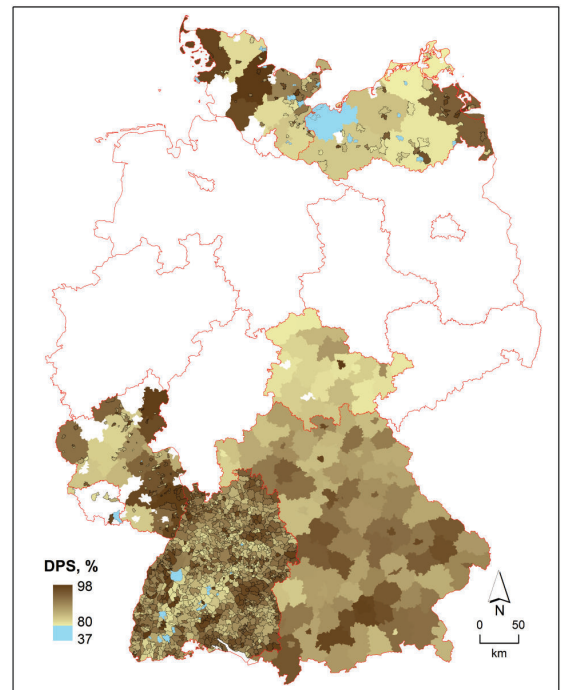


Fig.2 Degree of phosphorus saturation (in %) for arable land in Germany (areas with black outline are input data for extrapolation on district level; data for BY and TH was provided on district level)

Conclusion

Based on our results existing soil PCAL data can be used to calculate WSP data according to $WSP = 0,2646 \cdot PCAL$. The complex parameter DPS, which is widely accepted as risk parameter for the P loss potential from arable land, can be calculated by correlation between WSP and DPS. The delineated DPS map including data from German authorities shows elevated risks of high P losses from arable land. With our results we provide an approach to create spatially distributed input data for an harmonized modelling of dissolved phosphorus losses on large scales based on existing field data.

Literature:

Fischer et al (2015). A new database for modelling dissolved P losses in Germany (in preparation)
Pöthig, R., Behrendt, H., Opitz, D., Furrer, G. (2010). A universal method to assess the potential of phosphorus loss from soil to aquatic ecosystems. *Environ Sci Pollut Res* 17(2): 497-504
Schick, J.; Kratz, S.; Rückamp, R.; Shwiekh, R.; Haneklaus, S.; Schnug, E. (2013). Comparison and Inter-Calibration of Different Soil P Tests Used in the Baltic Sea Countries, Baltic Forum for Innovative Technologies For Sustainable Manure Management, Knowledge Report: 47pp.
VDLUFA (2002). Bestimmung von Phosphor und Kalium im Calcium-Acetat-Lactat-Auszug, VDLUFA Methodenbuch Band 1 Die Untersuchung von Böden, 3. Teillieferung

Data:

BY: Bayerische Landesanstalt für Landwirtschaft (2014), BW: Landwirtschaftliches Technologiezentrum Augustenberg (2014), MV: Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg-Vorpommern (2015), RP/SL: Dienstleistungszentrum Ländlicher Raum Rheinhessen-Nahe-Hunsrück/Fritsch (2015), SH: Landesamt für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (2015), TH: Thüringer Landesanstalt für Landwirtschaft (2013)