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Geophysical Research Abstracts
Vol. 19, EGU2017-19630, 2017
EGU General Assembly 2017

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Plant-available soil phosphorus (P) accumulates primarily in the topsoil due to P fertilization and P released from crop residues. In contrast with conventional tillage (moldboard plough, MP), conservation tillage [e.g. no-till, (NT)] often leads to higher P concentrations in the topsoil mainly due to the absence of mixing between soil, fertilizer, and crop residues. Our objective was to estimate the proportion of P uptake from a given soil mass across the soil profile under maize and soybean as the product of root surface density proportions and local plant-available soil P. This study was conducted on a long-term field experiment initiated in 1992 in southern Quebec, Canada, and established on a clay-loam soil under MP and NT systems. The experiment was factorially treated with three P doses (0, 17.5 and 35 kg P ha-1 applied as triple superphosphate on maize at 5 cm depth and at 5 cm on one side of the crop row). Soil was sampled at flowering stage at five depths (0–5, 5–10, 10–20, 20–30 and 30–40 cm) and three horizontal distances perpendicular to the crop row (5, 15 and 25 cm) in 2014 and 2015 to map a grid soil P availability to plants, e.g. phosphate ion concentrations in solution and the time-dependent amount of phosphate ions that can equilibrate- solution by diffusion, root distribution, and consequently crop P uptake, which was calculated as the fraction of plant-available soil P intercepted by surface roots. In general, NT tended to have higher soil P status in the upper soil layer and lower soil P status in the deeper soil layer compared to MP ; confirming previous results obtained from the same experimental site. This variation along the soil profile was significantly affected by sampling distance to crop row with higher concentration observed at 5-cm distance mainly because of the placement of P fertilizers. The 2D distribution of P uptake depended on tillage practice and P fertilization. There was higher proportions of P uptake from the 0-10 and 0-20 cm layers in NT (46% and 79%, respectively) compared to MP (25% and 68%, respectively). On average 8% of P uptake originated from the 30-40 cm layer irrespective of tillage, indicating that plant P uptake from deeper soil layers also influenced the P cycling in agroecosystems.