Molybdate reactive phosphorus is often used as a surrogate measure of bioavailable phosphorus in surface waters and soil solution. Its determination is conventionally performed on collected samples in the laboratory using manual or automated spectrophotometric methods. In an article published in the May–June 2014 Journal of Environmental Quality, scientists from the University of Melbourne and the Victorian Department of Environment and Primary Industry, Victoria, Australia and Chiang Mai University, Thailand, describe the evaluation of simple, low-cost microfluidic paper-based analytical device (µPAD) for the determination of reactive phosphate in soil solution.

Microfluidic paper-based analytical devices were originally conceived for point-of-care medical diagnosis, but they are increasingly being designed for environmental applications. The µPADs used in this project consist of credit-card-sized assemblages of paper that have been patterned with hydrophobic coatings using inkjet printing to define hydrophilic zones for sample and reagent deposition. Molybdate reagent and a suitable reagent are deposited and dried in defined reagent zones on the µPAD, which is then encapsulated using a card laminator. A typical µPAD can be prepared with 15 sample zones per card that allow replication of standard and sample addition for each card. After addition of a few microliters of sample and calibrant solutions to the µPAD, a development time of 9 to 11 minutes is required, after which the color intensity is measured using a simple desktop or portable scanner. After image analysis of sample and calibration data, using a freeware program, the concentration of reactive phosphorus can be computed.

With field applications in mind, the team also investigated some factors influencing the reliability and stability of the µPADs. These included a study of their photo-stability under ambient outdoor light conditions as well as reagent stability with time. By modifying laminating material, undesirable photochemical reactions were largely eliminated, and by minor modification of the µPAD assembly, the µPADs were usable for up to 15 days when stored under ambient temperature and longer when refrigerated.

Given the low cost and simplicity of these devices, the analytical performance was surprisingly good. The proposed method showed a linear response between 0.1 and 1.0 mg L⁻¹ and from 1.0 and 10.0 mg L⁻¹ with a limit of detection of 0.05 mg L⁻¹. When applied to the analysis of soil solution, there was excellent agreement between results obtained using the µPAD and those obtained using a laboratory reference spectrophotometric method. The ability to perform reactive phosphorus measurements using simple, low-cost µPADs with quantification using a simple optical scanner means that these devices are amenable to on-site application in agricultural and environmental nutrient assessment.