

Determining nutrient release from slow-release fertilizers through electrical conductivity measurements

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Slow-release fertilizers may increase nutrient use efficiency and minimize environmental impacts, particularly for nitrogenous fertilizers. Basically, two major groups of slow-release fertilizers can be distinguished: low solubility products and, more commonly, use of coatings on soluble products. The coating acts as a physical barrier, which either requires diffusion of the nutrient through the coating or disintegration of the coating for the nutrient to be released. Methods to determine the release of nutrients usually rely on chemical analyses, which often are time-consuming and/or expensive. We developed an easy method to measure release of nutrients from slow-release fertilizers through determination of the electrical conductivity (EC), which is a fast, inexpensive and reliable measurement. The release of nutrients from the granules in water is determined by measuring the EC at different times depending on the release rate. In the case of ionic fertilizers (e.g. phosphate, ammonium or nitrate fertilizers), the EC can be immediately determined and is converted to a concentration based on a product-specific calibration curve. In the case of urea, an additional step is needed to convert the neutral urea molecule to charged ions by adding urease to a subsample, which is left to equilibrate after which the EC is determined. Preliminary experiments were carried out to determine the concentration of urease needed to attain near full hydrolysis of urea within one hour. Nutrient release rates in water were assessed for a range of commercial and laboratory-coated fertilizer products. For some phosphorus (P) fertilizers, the release rates were also determined in soil using a P visualization method, by comparing the P diffusion zone around a coated granule with that around uncoated granules. Similar release rates were found in water as in moist soil. The EC method hence offers an easy way to quickly evaluate the release of nutrients from slow-release fertilizers.