



5072 Vista View Crescent
Nanaimo B.C. V9V 1L6
Canada

Malley, D.F., P.D. Martin, and P.C. Williams. 2005. Performance of a field-portable, in-stream hog manure nutrient sensor prototype in the laboratory. PDK Projects, Inc. December. Revised June 2006. 33 pp.

Executive Summary

Hog manure is recognized as a valuable nutrient resource. Proper manure management can result in the replacement of a portion of inorganic fertilizers with manure, reduction of undesirable impacts of waste nutrients on aquatic ecosystems, and reduction of releases of the potent greenhouse gas, nitrous oxide. Management of hog manure will be significantly aided by the development of a real-time, in-stream nutrient sensor that can be deployed on-site at the time of pump-out of manure stores to measure the composition of this highly variable material.

This project documented the performance of a laboratory prototype system consisting of a flow-through cell mounted on a Zeiss Corona near-infrared spectrometer for the prediction in flowing manure of density, total solids and moisture content, ammonium-nitrogen, total dissolved nitrogen (N), suspended nitrogen, calculated total nitrogen, orthophosphate phosphorus (P), total dissolved phosphorus, suspended phosphorus, calculated total phosphorus, and suspended carbon (C). Samples were scanned from 960 to 1690 nm.

The 381 manure samples in this study were collected from May to July 2004 during pump-out from 11 hog operations in southern Manitoba, Canada, including those with one-celled, two-celled and three-celled earthen manure stores. The samples provided a sufficient range of composition to be suitable for analysis by near-infrared spectroscopy.

The recirculating system tested 1-litre samples of manure in 7 sec. Three pathlengths (thickness of the manure presented to the instrument) of 3, 7, and 13 mm were tested. The cell with a 3-mm pathlength was prone to clogging. Pathlengths of 7 and 13 mm gave virtually identical results. Therefore, a pathlength of at least 13 mm is recommended for further development.

Calibrations were based on 128 of the 381 samples. Using statistical criteria, the calibration for orthophosphate P was judged as excellent. Calibrations for density, total solids/moisture, suspended N, total N, total dissolved P, suspended P, total P and suspended C were successful. The calibrations for ammonium-N and total dissolved N were moderately successful.

In conclusion, the prototype system demonstrated that concentrations of N, P, and C, as well as density, total solids, and moisture can be successfully predicted in flowing hog manure using near-infrared spectroscopy. The system demonstrates with North American hog manure samples that the concept of a real-time, in-stream manure nutrient sensor is feasible.