# ACTIVE SENSOR FOR REAL-TIME DETERMINATION OF SOIL ORGANIC MATTER

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## ABSTRACT

Soil organic matter influences chemical and physical properties in the root zone as well as soil biological activity and plant vigor. As such, it is reasonable to assume that there are probably opportunities for producers to incorporate soil organic matter concentration information into their management decisions. However, soil organic matter is usually notoriously variable within fields. An active sensor based on in-soil reflectance was developed to provide apparent real-time organic matter data. Anticipated use of this information by producers includes variable-rate planting and nutrient application decisions. Preliminary efforts to calibrate the sensor using an expanded set of bench-mark soils showed that those within a major land resource area in Nebraska followed a linear trend (lower reflectance with higher organic matter content). Samples from soil developed under forested conditions typically contained higher carbon concentrations but still generated a weak regression. Soil reflectance from a field transect showed that the sensor values were highly correlated with organic matter content. Strategies to calibrate the sensor will be presented using data from a high-intensity grid sampled field.

## INTRODUCTION

Soil brightness has long been known to decrease as organic matter content increases. However, water (increased soil moisture content) enhances the contrast in soil colors. Aside from the effect of soil water content on brightness, soil reflectance generally increases in a near-linear manner from blue light (~400 nm) through green, yellow, orange, and red to near infrared (NIR, 760-900 nm). As noted, the brightness of surface soil is influenced by ever-changing water content and probably changes spatially and temporally based on landscape position and soil texture. This situation limits the applicability of using remote sensing (satellite or aircraft) to map soil color. Residues from previous crops further confound reflectance from the landscape.

The surface few centimeters of soil do not usually contain many roots nor reliably contribute to N mineralization because of fluctuating water content.

Therefore, it should be intuitive that the soil organic matter content of interest would be the surface 30 cm because modelers estimate that ~85% of the corn roots and most of the N mineralization occur in that layer. The goal of this research was to develop and test an active soil organic matter sensor that would operate at a depth of 10 to 15 cm where soil water content should be relatively immune from surface drying effects and the effects of residue cover.

## MATERIALS AND METHODS

The active sensor used in this study was designed by Holland Scientific using some of the principles and circuits used in the ACS-210 Crop Circle canopy sensor. The sensor was housed with a 15 x 7.5 x 1.59 cm (length, width, thickness) stainless steel body with a Safire window. The sensor used in this study contained green and near infrared (NIR) wavebands and was attached to a chisel that recorded reflectance data at 10 Hz from ~10-cm depth while traveling a ~6 kmph. The field was under center-pivot irrigation and received 6 cm water three days before measurements were taken. Soil textures in the field transect ranged from sandy loam to silt loam.

## RESULTS AND DISCUSSION

Soil organic matter content in the surface 20 cm was determined from grid-samples collected from a 60-ha field (34 samples/ha). Organic matter content in samples from both sides of the 600-m long transect were correlated with sensor reflectance measurements and expressed as organic carbon content. A sample of the data shows the sensor (green and NIR wavebands) is responsive to soil brightness. The sensor and coulter apparatus worked very well to cut through residues. Soil brightness measurements were taken at ~10 cm depth.