3-D laser scanning: A new soil quality measurement

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Soil researchers pay close attention to bulk density, as it is one of the most common soil measurements and it is often used as a measure of soil quality. A soil's bulk density can be indicative of the ease of root penetration, water movement, and soil strength. Measuring this value with traditional methods has been difficult in the past, but researchers have developed a new method using laser scanning technology.

Scientists at the University of California-Riverside have learned to apply the use of automated three-dimensional laser scanning to measure bulk density of soil clods and rock fragments. A commercially available desktop three-dimensional scanner was used in the study, and the results are published in the November-December 2008 issue of the *Soil Science Society of America Journal*. The research was funded by the University of California Kearney Foundation of Soil Science.

Past conventional methods of measuring bulk density that have been used include the clod method. With this system, intact soil clods are coated with an impervious substance, such as liquid paraffin or saran, and clod volume is measured by water displacement. This method can be difficult and labor intensive. After measuring clod volume, gravel fragments must be removed from the clod and weighed so that bulk density can be expressed for the fine earth fraction. Removing the coating is difficult, making the separation of gravel tedious and subject to error. Furthermore, the clod is destroyed, eliminating the possibility of additional analyses on the same sample.

To test the laser scanning method, soil clods of varying textures were collected and scanned using the three-dimensional scanner during summer 2007. Scanned images were assembled to create a three-dimensional image of the sample and calculate clod volume. Bulk density of the same clod was measured again using the paraffin-coated clod method, and gravels were removed after volume was determined by the paraffin-coated clod method. Gravel-free bulk density was calculated using measurements made by both methods.

The results showed the success of the laser scanning method, as the volume measurements determined by the three-dimensional scanner and the coated clod method showed excellent agreement across a wide range of soil textures (loamy coarse sand, silt loam, sandy clay loam, and sandy clay) used in this study. Calculated bulk density values also showed close agreement between the two methods.

The three-dimensional laser scanning technology offers other benefits, according to article author Ann M. Rossi of University of California-Riverside Soil and Water Sciences Program. Three-dimensional images of peds can be used to make visual displays of soil structure, and to make quantitative determinations of ped properties related to structure type, size, and grade. The technology can also be used to measure surface area, allowing for assessments of surface roughness.

Through careful use of this three-dimensional laser scanning technology in measuring soil bulk density, researchers can conduct a more thorough analysis of a soil's quality, helping to further understand how healthy crops are produced.

Source: Soil Science Society of America