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Soil fragmentation study applying different tillage systems

Juan Matos (1), Ana Maria Tarquis (2,3), and Humberto Millán (1)

(1) Universidad de Gramma, Cuba (jmatost@udg.co.cu, hmillanv@udg.co.cu), (2) CEIGRAM - ETSI Agónomos, Universidad Politecnica de Madrid, Madrid, Spain (anamaria.tarquis@upm.es), (3) Dpto. Matematica Aplicada, ETSI Agónomos, Universidad Politecnica de Madrid, Madrid, Spain

Soil aggregate-size distribution (ASD) is a fundamental soil physical attribute with dominant influence on many other soil properties. A sieve analysis combined with fractal analyses have proven to be useful to obtain precise information from ASDs. The aim of this work was to assess similitude or difference of ASDs sampled on plots of an experimental field applying several tillage systems and belonging to the same textural class using fractal parameters. The field experiment consisted of four tillage treatments and three consecutive cropping systems. It was conducted with nine replicates for each tillage treatment and crop on a Fluvisol (Aluvial) presenting a sandy clay texture. Tillage treatments were conventional tillage (T1), minimum tillage (T2), maximum tillage (T3) and moldboard plow and disk-Harrow tillage (T4) while crops were potato (Solanum tuberosum L.); boniato (Ipomoea batatas (L.) Lam.) and yuca (Manihot esculenta Crantz).

In order to characterize several soil properties along the three different crops, bulk density, total porosity, rupture module (MR) and mechanic impedance (RP) were measured at three different soil depths (0-10, 10-20 and 20-30 cm). Aggregate-size distribution analysis by the sieve between 150 and 10 mm of diameter at dry and soil retract limit (LR) were used to estimate fractal fragmentation dimensions at the two humidity stages for each sample and at partial and total fragmentation, D and Dr respectively. In our case, soil retract limit correspond to 120 g/kg.

Respect to the fractal parameters, D and Dr showed that fractal distribution was a suitable model for ASDs obtained by sieve analysis in a range of scales of 150 to 25 mm aggregate diameter obtaining in all cases R2 higher than 0.95. Results showed that the tillage treatments had a significant effect on fractal fragmentation parameters estimated at soil LR, meanwhile it wasn't significant among the crops studied. Among the four tillage systems, T2 shows a better sustainability of soil structure and at the same time gives the higher crop yield. Respect to the physical parameters, a linear relationship between MR and RP was found and estimated at two different soil depths.

Even these experiments has been developed under crop production conditions of the Yara county (Granma, Cuba), the methodology can be applied to different field conditions and crops to extend the interpretation of these fractal parameters.