Geophysical Research Abstracts
Vol. 15, EGU2013-1483, 2013
EGU General Assembly 2013

Effect of freeze-thawing on aggregate stability in a calcareous Mediterranean soil

Elena Lozano, Beatriz Temporal, Ángel Oltra, Jorge Mataix-Solera, Victoria Arcenegui, and Fuensanta García-Orenes

GEA (Grupo de Edafología Ambiental). University Miguel Hernández, Agrochemistry and Environment, Elche (Alicante), Spain (jorge.mataix@umh.es, +34 96665 8340)

Soil freezing has been reported as both beneficial and detrimental for soil structure depending on various factors (Dagesse, 2011), but the subsequent thawing process has not been adequately investigated as a factor in determining the net effect of freezing and thawing.

In this study changes in soil aggregate stability (AS) were studied under different moisture and speed of thawing conditions in a laboratory experiment. Conditions favoring sublimation and commonly experienced during the winter include bare soil surfaces and synoptic meteorological conditions of clear skies, low humidity, and moderate winds. Aggregate stability measured may therefore reflect the effects of drying of the soil aggregates via the freezing process and the resulting water content distribution following thawing. The soil used is from an agricultural area located in Sierra de Enguera (Valencia, E Spain). Soil samples were collected in February 2012 from the first 2.5 cm depth of A horizon. We also studied the effect of a mulch cover in buffering soil temperature during 2 months under field conditions using thermocouples and data-loggers.

Soil samples at two initial water contents (10% and 40%) were subjected to different treatments, including not frozen (control), freeze-thaw (freezing at -4 ºC for 3 h and thawing at room temperature for 24 h) and freeze-drying (freezing at -4 for 3h and thawing at 60 ºC for 3 h in a forced air oven). We measured the possible soil disruption of soil aggregates quantifying the soil mass in the fractions 2-0.25 mm and <0.25 before and after each treatment. Aggregate stability of the 2-0.25 mm fraction was also studied using a rainfall simulator.

Our result showed significant differences between treatments. The freeze-thaw treatment was typically destructive in nature. The disruption of soil aggregates increased in proportion with the initial water content of the soil, and significant differences were found with the type of thawing, fast drying being the most destructive. The stability of the remaining aggregates also increased with the initial soil water content before freezing, but this increase could be due to the selection of the most stable as a consequence of the disruption of others.

As for the mulch cover, a clear effect of buffering temperatures was observed. The maximum and minimal daily temperatures were found in the bare soils. The mean difference between covered and bare soil was around of +3.6 ºC for minimum and – 8.9 ºC for maximum temperatures.

In conclusion, the freeze-thawing processes are a cause of disruption of soil aggregates but the magnitude depends on the initial soil water content, and the velocity of thawing. The increase of AS after the treatments seems to be due to the persistence of the most stable aggregates. With reference to the mulch cover in field conditions, we can conclude that it may well be an adequate strategy to avoid the effects of freezing on soil structure.

Key words: freeze-drying, freeze-thawing, aggregate stability, mulching

Dagesse, D. (2011). Effect of Freeze-Drying on Soil Aggregate Stability. Soil Science Society of America Journal: 75: 2111–2121.