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Effects of experimental repeated fires in the soil aggregation and its temporal evolution

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Forest fires are an important problem in the Mediterranean and change our forest topsoils with still unknown consequences for important ecosystem services, such as water availability, plant growth and carbon sequestration. The total area affected by forest fires in Mediterranean countries of the European Union has declined since 1980, and the number of fires in this region tends to stabilize. However, in countries like Spain and Portugal the number of fires tends to increase. This fact seems to support future predictions indicating a general tendency to increase the number of forest fires, related to the climate change. According to European Forest Fire Information System (EFFIS), 102349 ha of the Spanish forest surface were burned in the summer of 2012 (01/06- 11/08/), of which 54186 ha were registered in the Valencia region.

In this sense, to assess post-fire soil recovery aggregate stability has been used as an indicator in the Experimental Station of La Concordia (Valencia, Spain), where experimental fires were carried out in1995 and 2003, in a set of nine plots (20x4m). The soil studied is a Rendzic Leptosol. The stability of macroaggregates (SMS, Ø >250 μm), soil organic matter (SOM) and calcium carbonate contents, aggregates size and water erosion processes, were analysed in relation to fire severity and its recurrence, in two environments (under canopy, UC, and bare soils, BS), and in the short- and medium-term of two fires.

In 1995, different fire treatments were applied to obtain different fire severities: three plots were burned with high severity fire, other three plots with moderate one, and the remainder plots were left unburned (control). In 2003, the same plots were burned again with low severity fires. The study was performed until summer of 2007. In general, soil environment explained significant differences in the soil properties between under canopy and bare soils. Only in the short-term of repeated fires, $CaCO_3$ content, macroaggregate mean weight diameter (MWD) and microaggregate mean diameter (MMD) values were similar in both soil environments.

The different severities of 1995 fires, and its recurrence in 2003, did not cause any change in the SMS, however an upward trend was observed with final values ranging between 35-40% in soils under canopy, and between 25-30% in the bare. The aggregate size distribution changed significantly in the short-term of both fires and, consequently, the final MWD decreased ($\sim$30% UC). SOM content of the UC burned with high severity tended to decrease after the first fire, but increased in those soils in moderate severity. Decreasing SOM trends were found in the short-term. After the repeated fires in 2003, no change was measured. Low organic matter incorporation was demonstrated (8-10% UC, 6.5-7.5% BS). The $CaCO_3$ content was very high and continued increasing after 1995 fires. There were no short-term changes after 2003 fires, but in the medium term tended to decrease (50-55% BS, 45-50% UC).

The organic matter seemed to be responsible of macroaggregates stability in the control soils; meanwhile the $CaCO_3$ had a low participation. The role of both cementing agents in burned soils was not clearly established, although it is assumed that the high SOM content was more important than that of $CaCO_3$, which might have some involvement in the MMD.

Finally, it was established that runoff and sediment yields depend on fire severity, as well as on intensity and volume precipitation. Such erosion rates were significantly higher in the

burned plots than in those unburned. Although in the medium term runoff tended to decrease, the high sediment rates confirmed the poor recovery of burned plots.