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Use of a mesoplot rainfall simulator to characterize the hydrological behaviour of runoff plots under two different soil management techniques.

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This communication describes a mobile rainfall simulator for mesoplot studies, the calibration tests required for its development, and its performance for evaluating runoff and sediment losses in an experiment on an olive grove under two different soil management methods.

The rainfall simulator is based on commercial sprinkles overlapping an effective area for rainfall simulation experiments of 8 x 18 m. It uses a portable power generator, water pumps and five water tanks (of 3000 l each). It is inspired in the design of Sumner et al. 1996. The whole equipment fits into a 700 kg trailer and can be served by a team of three people. In areas without water supply water can be transported in trucks or tractors and stored into the tanks.

The calibration tests indicated that the rainfall simulator can provide rainfall intensities from 15 to 35 mm h-1, depending on the number of nozzles used and the water pressure. Calibration tests indicated that it provided acceptable uniformity, an average value of the Christiansen Coefficient of Uniformity (Christiansen, 1942) of 85%, when used under wind velocities below 1 m second-1. Above this wind velocity the rainfall simulator should be used in combination with wind screens. This is not always a feasible option, as in the experiments performed in rainfall orchards where the sprinklers had to be located 3 m high to be above the olive tree canopies.

In an olive orchards located in Pedrera, Southern Spain, two runoff plots under different soil management methods were selected for testing the rainfall simulator in the field. The two soil management methods evaluated were conventional tillage and a cover crop of ray grass sown in fall and chemically killed with herbicides in late March. These plots had been established five years before the rainfall simulation experiment. Three rainfall simulations were made on each of the two runoff plots. The rainfall intensity used was always 33 m h-1, and lasted 60, 60 and 45 minutes for the first, second and third simulation on each plot respectively. The first rainfall simulation was made on dry soil, the second simulation was performed in moist soil 24 hours after the first simulation and the third one was made on saturated soil made one hour after the end of the second rainfall simulation.

The results of this experiment indicate that the cover crop runoff plot presented a slightly higher runoff generation compared to the conventionally tilled plot, 6.93 vs. 4.13 mm of cumulative runoff for the three simulations respectively. However the tilled plot presented soil losses higher than the cover crop plot, 0.32 t ha-1 vs. 0.14 t ha-1, cumulative losses for the three simulations on each plot. Both plots presented significant losses of nutrients and organic matter, for instance 7.6 and 5.3 kg ha-1 losses of organic matter in the tilled and cover crop respectively for the whole experiment.

The results of this experiment indicates that in some soils, such as the one of our study, in situations of high rainfall intensity on moist or saturated soils olive orchards managed with cover crops can still been a significant source of nutrients and organic matter to water streams. This can be explained by a combination of significant runoff generation, and sediment enrichment due to selective transport of finer soil particles and increase in nutrients and organic matter in the topsoil of the cover crop managed orchards compared to tilled orchards.

References

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