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A medium scale mobile rainfall simulator for experiments on soil erosion and soil hydrology

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Numerous types of rainfall simulators (RS) have been used to the study the behaviour of surface runoff and sediment transport caused by rainfall. It has been documented, that reproducibility and the knowledge of test conditions are essential for gathering necessary and comparable data. Therefore medium, to large scale field rainfall simulators are very desirable. Such devices are nevertheless very much time and laboratory consuming and their weakness is especially a high water consumption.
A new, compact and mobile medium scale rainfall simulator has been developed under close cooperation of CTU Prague and Research Institute of Soil Conservation.
The main idea was to develop a device, which is easily to handle by 4 persons, transportable with trailer behind an off-road car and independent of additional water sources and energy.
Therefore, a special construction fixed on a standard trailer has been developed. It consists of an aggregate to produce power, an electric pump and a water tank with a capacity up to 1000 l. The pump can work in reverse mode, what allows filling the water tank from any source, including stream or pond. The capacity of the tank is normally sufficient for experiments with duration up to 30 minutes. The RS itself consist of a folding arm, which carries 4 nozzles (SS Full Jet 40WSQ), controlled by electromagnetic valves, which allow to set up desired rainfall intensity by opening intervals. A simple logical unit allows programming various schemes of operation of individual nozzles, to keep low pressure fluctuation in the system. The arm is first unfolded into total length of 9.6 m and then lifted up, using simple crab to its operation position which is 2.3 – 2.65 m above terrain surface. The distance between individual nozzles had been optimized based on number of calibrating experiments on 2.4 m. There is also special space at the trailer for transportation of metal sheets and collector (for experimental plot), additional equipment, tools and measurement devices. To prevent the wind effect, whole construction can be easily covered by tarpaulin.
The experimental plot has a basic size of 9.5 x 2 m, however, we usually use only 8 x 2 m. The nozzles are fed with a water pressure of about 0.8 bars. Various schemes of opened nozzles allow varying rainfall intensities between 40 and 80 mm.h-1. Rainfall collectors were used to measure spatial rainfall distribution. The spatial rainfall distribution on the entire plot is higher than 80% (Christiansen-Uniformity Coefficient).
Drop size distribution and drop fall velocities were analyzed by means of a Laser Precipitation Monitor (by Thies) with satisfactory results. The mean drop sizes ranging between 0.75 – 2.00 mm depending on applied intensity. Resulting kinetic energies ranging from 188 – 582 J m-2 mm-1. The measured rainfall variables show low fluctuations throughout the tests and are therefore reproducible in field investigations.

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