Evaluation of surface runoff conditions by high resolution terrestrial laser scanner in an intensive apple orchard

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Abstract

High resolution terrain data and plant coverage are essential input SWAT parameters. Extreme water management features of soils can be evolved due to the heterogenic micro relief and extreme weather conditions – which caused by climate change – in the Carpathian basin, in Hungarian Great Plain. These factors can saturate soil conditions in root zone, but drought can appear, often in the same year and in the same area. Due to the small runoff conditions, terrain modeling of flat areas are important, which are influencing the runoff pattern. This runoff pattern is modified by horticultural techniques and by the weed patches. In order to determine the micro relief characteristics of the soil, sometimes special instruments and high vertical accuracy are needed, which are provided by developed technological elements (global positioning system, geographical information system and remote sensing).

We have evaluated the micro relief features and spatial and temporal development of weeds on an intensive apple orchard on the Study and Regional Research Farm of the University of Debrecen (lat.: 47.592508; long.: 21.639914), Hungary. The experimental plot is situate in an area of semi-arid climate conditions. This study area was 1,500 m^2, the soil type is light sandy. Elevation values were measured by Leica ScanStation C10 3D laser scanner, which provided millimeter accuracy spatial data. The so-called laser point cloud contained more than 36 million of points (24,167.44 pts/m^2). This high spatial resolution dataset was suitable to detect the micro morphological features of the soil surface, so micro watersheds and runoff condition were defined and evaluated.

Besides the laser surveying, we have measured the soil compaction with penetrometer to complete the runoff conditions data. Spatial and temporal changes of weed coverage was investigated by GreenSeeker 505 vegetation index meter to evaluate the effect of runoff of soil. The instrument measures the vegetation activity on the plot area.

Based on the results, it could be determined that the slight slope and soil compactions are important factors for water flow direction, which have influenced the distribution of weed flora even on this flat area. These data can help to decrease the problems of surplus water and drought in the field on extreme flat areas. Acquired data can well approximation after exact calibration.

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Keywords

Runoff conditions, weed coverage, terrestrial laser scanner, vegetetion indexmeter