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Analysis of rainfall inputs and runoff under an A-frame oscillating rainfall simulator in a sugarcane field, Mackay region of Queensland: Matching measurement techniques to meet project water balance objectives

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A total of 11 rainfall simulations were conducted on four different plots (ranging in area from 22.10 to 26.20 m^2) in a sugarcane field (with slopes varying from 1-9% and a groundcover variability of bare – 100% cover) in the Mackay region of Northern Queensland. The objectives of these rainfall simulation experiments were many, but this paper discusses the measurement methodology and data quality of rainfall generated and subsequent runoff.

Rainfall amount during the simulations was measured using two different sizes of rain gauges placed at different locations on the plot (left, centre, and right sides of the experimental plot). In addition to the 203mm ordinary rain gauges, three pluviometers (300mm) were placed along the centre of the plot to measure rainfall as a function of time during the simulation. The rainfall data from these three pluviometers was collected using dataloggers and processed using a computer program called Datalog, which converted the number of tips/minute into mm/h. Due to spatial variation of rainfall intensity applied to the surface as a function of height from the nozzles of the rainfall simulators, correction factors were determined using a computer program called ERFS developed for this purpose. The rainfall from each gauge and pluviometer was subsequently corrected for distance from the nozzles of the simulator and height of the gauge by multiplying it by the corresponding correction factor. The spatial distribution of rainfall amount during each simulation was determined by spatially interpolating measured amounts in order to ascertain the best estimate of applied rainfall and its energy.

Runoff data during each simulation was collected using tipping buckets connected to data loggers. Runoff amounts were also manually collected at specified intervals as a back up, and for validation of those collected using tipping buckets in determining runoff rates for each simulation.

Soil cores were taken for determining soil moisture balances at soil profile depths of 0 10, 10 20, 20 30, 30 40, and 40 50 cm before and after each simulation.

Results showed that:
1. Rainfall surfaces produced by interpolating measured amounts exhibited variability by the same nozzles across all simulations. The spatially adjusted mean for each run was assumed to represent the average for the plot.
2. Comparison of runoff data from the tipping buckets with those collected by hand showed a high level of agreement boosting our confidence in these data.
3. The water balance results using the soil moisture cores were poor, highlighting the problems associated with the spatial variability of infiltration and the effects of growing plants even at a small plot scale..

The implication of these results on nutrient balances will be the subject of another paper.