International Journal of Agricultural Engineering, Vol. 2 No. 1 : 46-49 (April to September 2009)

Hydraulics of rainfall simulator

A.S. KADALE, M.S. PENDKE, H.G. DESHMUKH AND S.D.PAYAL

Accepted : ***January, 2009***

See end of the article for authors' affiliations

Correspondence to:

A.S. KADALE
Department of Soil and Water Conservation Engineering, College of Agricultural Engineering and Technology, Marthwada Agricultural University, PARBHANI (M.S.) INDIA

ABSTRACT

A rainfall simulator was designed and its hydraulics parameters such as rainfall intensity, uniformity coefficient, raindrop size and terminal velocity were studied under different operating pressures. Rainfall intensity was found to be decreased with increasing the operating pressure. The values of uniformity coefficient were found to be more than 80 %. The raindrop size of simulated rainfall ranged between 2.48-3.25 mm. Maximum and minimum terminal velocity was observed when raindrop size was 2.48 mm and 3.25 mm, respectively.

Key words : Rainfall simulator, Uniformity coefficient.

In soil and water conservation engineering, experiment on runoff and soil loss are mainly depend upon the rainfall, which is always unpredictable in terms of timing, quantity, duration and distribution (Suresh, 2000). Since the occurrence of rainfall (being natural phenomenon) is beyond human control, replication and verification of an experiment under similar rainfall conditions at a place becomes difficult, if not impossible. Under these situations conducting studies related to runoff and soil loss in a field, using natural rainfall, becomes a tedious time consuming, labour intensive and costly process. Some times it may also lead to erroneous outcomes due to deviations and approximations in input rainfall parameters.

As an alternate approach, these experiments can successfully conducted under artificially generated rainfall, generally called as simulated rainfall, by using rainfall simulators. The rainfall simulator used for this purpose should have the ability to generate rainfall nearly similar to the natural rainfall which is controlled and reproducible in nature. Thus, rainfall simulation provides an effective and convenient tool for infiltration, runoff, soil erosion and sediment outflow research which eventually necessitated the development of different types of rainfall simulation system by using different mechanisms. The mechanisms include hypodermic needles, polythene and plastic tubing, nozzles, rotating boom, glass capillary tubes, metal tubes etc. Kukal *et al.* (1999) developed a simple and portable simulator for small plot studies. It involves breaking a water jet with the help of a strong air current into a simulated rain shower.

Most of simulators developed in the past are complex and large. Therefore, there is need of small unit of rainfall simulator which must be simple in construction. Keeping this in view a rainfall simulator was designed and its hydraulics was studied.

METHODOLOGY

A rainfall simulator was designed to study the effect of rainfall intensity on runoff and soil loss. It consisted of water supply system, soil tray, water emitting device, runoff collection unit and wind guard. The water supply system consisted of centrifugal pump with suction, delivery and by pass line, control valves and storage tank. The soil tray was built of brick from all sides. The dimensions of soil tray were 3 m x 3 m. The verti soil in the tray was given 1 % slope so that runoff is collected in collection tank PVC and stainless steel showers of different sizes were tested. Among the tested showers a stainless steel shower, having circular plate with two holes of 2mm size fixed inside it, was found to be most suitable one as it produced selected intensities *i.e.* 5, 7, 9, 11 and 13 cm/hr at 1.4, 1.2, 0.9, 0.7 and 0.6 kg/cm^2 operating pressures, respectively. A circular plate fixed inside the shower helps to dissipate the pressure inside the shower. Due to pressure dissipation rainfall intensity decreased with increasing operating pressure. A stainless steel shower has 10 mm inlet diameter and outlet consisted of circular steel plate having 56 nos. of holes. Size of holes on circular steel plate of outlet was 1 mm diameter. Cement tank was used to collect the runoff. A wind guard was provided to prevent distortion of rainfall pattern. The rainfall simulator was operated at five operating pressures *i.e.* 0.6, 0.7, 0.9. 1.2 and 1.4 kg/cm^2 to obtain rainfall intensities 13, 11, 9, 7 and 5 cm/hr, respectively.

To determine uniformity coefficient (Cu) of simulated rainfall, the rainwater was collected in catch cans for 15