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The effect of vertical mulch on runoff and soil loss using rainfall simulator in black soil

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ABSTRACT : The rainfall simulator is a very handy and useful tool to have quick and comparative results between the treatments under simulated rainfall conditions involving much less cost and time. The results show that vertical mulching with sorghum stover, control the over land flow which in turn reduce the runoff from 45 to 30% for 1 % slope and 62to 57% for 2 % slope. This confirms that vegetative measures can be as effective as the graded or contour bund for conservation planning in black soil agricultural land having slope up to 2%. Simple application of mulch material on the surface upto 2% slope of the field, can act as good inter terrace soil and water conservation treatment in the black soil region, apart from improving in situ moisture conditions to increase crop production.

Key words: Rainfall simulator; Runoff; Soil loss; Vertical mulch

The rainfall simulator is a very handy and useful tool to have quick and comparative results among the treatments. It is a fact that soil erosion is a serious problem through out India and more specifically in black soils of various depth. Detail information on soil loss under different slopes, vegetative covers and rainfall characteristics is not available. This information is necessary for development of mathematical model for predicting runoff and soil loss to make specific recommendation for conservation and water resource planning in a given region. It will not be possible to generate information from field studies under natural condition because it is time consuming and costly and hence it is proposed to study under controlled condition to have comparative results between the treatment using rainfall simulator (Meyer 1958, Adhikari *et al* 1987). Vegetative barriers in different forms Such as mulches, contour cropping etc., are sufficient to reduce erosion to permissible limit on areas up to 2 % slope (Bhardwaj 1994). Similar studies using mulch material was also conducted (Khera and Kukal 1994). The results show that surface mulching with sorghum stover control the over land flow and erosion and reduce runoff by 10 to 20% (Adhikari 2002). Hence a study is initiated to determine the effect of slope and vegetative management practices (vertical mulch) on runoff and soil loss under simulated conditions.

MATERIALS AND METHODS

Development of rainfall simulator

Initially a hemispherical sprinkler type of rainfall simulator with manual oscillation was developed following the one used at IIT Kharagpur (Gulati 1964, Prasad 1969). The tests conducted revealed that distribution of simulated rain was not uniform over the soil and the intensity of the rain could not be varied. Apart from the above, the drop size was also not uniform with respect to space and time. Considering various types of simulators available, efforts were therefore made to correct the above deficiencies and develop an indigenous rainfall simulator by introducing a v-jet nozzle for uniform drop size connected to automatic oscillation system (16 oscillations per minute) fitted with a Solenoid value attached to a timer for spraying to effect changes in the solenoid valve attached to a timer for inter miltent spraying to effect changes in the intensity of simulated rainfall (Adhikari 1992). The clean water is pumped using a reciprocating pump having a facility to deliver the water at a constant pressure. The specification and treatment of rainfall simulator is presented below.

Type of rainfall simulator: nozzle type

Tray size	:	1.5 m X 1 m
Time of operation	:	15 minutes
Antecedent condition	:	Dry and wet
Treatment	:	Vertical mulch with 0.5 m interval @ 6 t ha^{-1} with 6 cm height across the slope
Slope	:	1 and 2 %
Observations	:	Runoff and soil loss observations were taken in bare and vertical mulched plot
Soil type	:	Vertisols

The initial characteristics of the soil determined were Bulk density 1.33 g cc^{-1}, particle density 2.04 g cc^{-1}, pore space 34 per cent; hydraulic conductivity 0.8 mm hr^{-1}, clay 545.5 g kg^{-1}, sand 232.7 g kg^{-1} and silt 211.50 g kg^{-1}.

Determination of coefficient of uniformity (CU)

The simulator as described above was fabricated and

put to test to determine the evenness of rainfall distribution over the plant area. The coefficient of uniformity (CU) was calculated by using the Christians formula (Thomas *et al.* 1989)

$$CU = 100\ (1 - \frac{\Sigma K}{MN})$$

Where CU is per cent coefficient of uniformity, M is mean value of simulated rainfall, N is number of observations and K is deviation of observations from mean. The CU was observed nearly 100% suggesting validity of plot size.

RESULTS AND DISCUSSIONS

Initially after standardising simulated rainfall was allowed over the soil tray for both dry and wet condition of 1 and 2% slope of bare soil and with the treatment. Wet soil gives more runoff and soil loss than dry soil because of increase in antecedent moisture content. The average value of dry and wet condition is discussed in this paper.

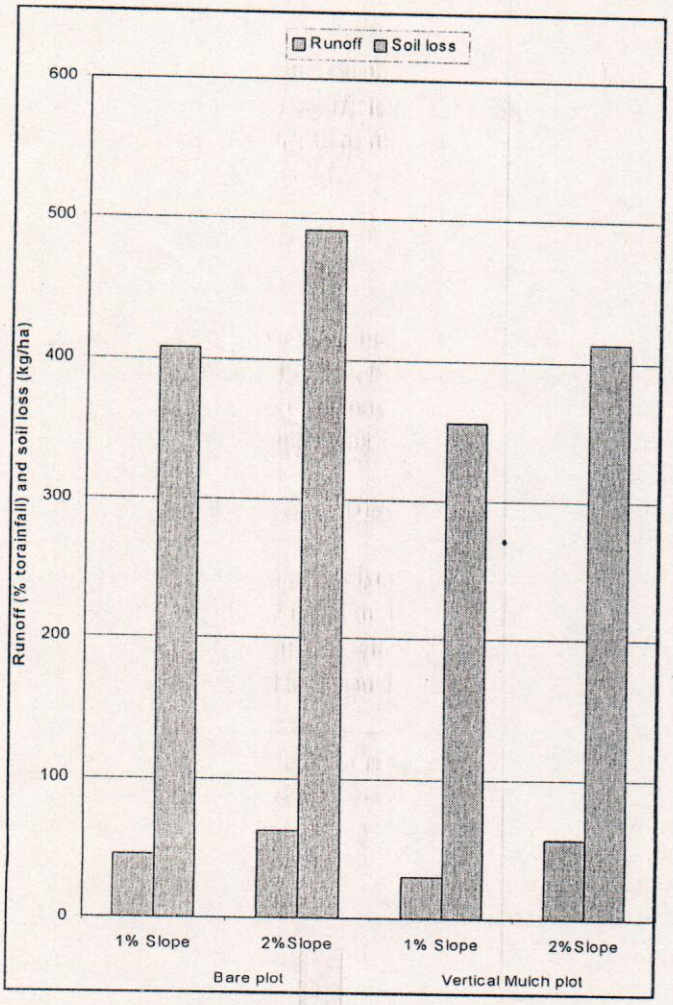

Fig.1. *Average runoff and soil loss on 1 and 2 percent slope from rainfall simulator.*

Results show that for 1 % slope runoff (% rainfall) reduced from 45 to 30 and soil loss from 408 to 356 kg ha^{-1} as a result of vertical mulch treatment (Fig. 1).

In the case of 2 % slope, vertical mulch reduced the runoff (% rainfall) from 62 to 57 and soil loss from 491 to 413 kg ha^{-1} (Fig. 1).

The observations clearly show that 2% slope generate more runoff and soil loss than 1% slope. It also shows that effect of vertical mulch treatment in 1% slope is more prominent than 2% in terms significant difference in reduction of % of runoff, which in turn help in situ moisture conservation besides improvement moisture availability and crop production. It also proves that vegetative barrier is effective only on lower degree of slope of land. Hence vegetative barrier like vertical mulch can be act as effective tool and suitable supplemental for costly mechanical measures like contour and graded bunding below 2% slope of the land as interterrace measures.

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