Estimation of Net Rainfall through Guava Tree for *In-Situ* Soil Moisture Conservation in Guava Based Hortipasture System in Central India

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Introduction:

Rainfall (R) falling on any vegetation can be partitioned in Stemflow (SF), Throughfall (TF) and Interception loss (I). Stemflow is that part of rainfall which flows down to the ground *via* leaves, stem, branches and trunk (above ground vegetative part). Throughfall is the part of rainfall which drips down through the canopy to the ground. Interception is the part of the rainfall after absorption by different parts of tree which remains with the above ground vegetative part and later on lost by the process of evaporation. Thus, SF and TF are combined termed as net rainfall and flow as runoff after meeting the infiltration demand of the soil. The water balance equation of rainfall falling on vegetation is written as, R=SF+TF+I.

In wooded ecosystem, SF and TF are most important which account about 70-90% of the incident rainfall and rest goes to interception loss (Bryant *et al*., 2005). Proportion of the rainfall partitioned components depends on different climatic factors and Plant canopy architecture properties. These climatic factors include rainfall amount, intensity, duration, wind speed and its temporal distribution whereas canopy properties are canopy structure, leaf area index (LAI), leaf branch properties *etc*. Levia *et al*. (2010) showed that SF volume depends on tree species, crown size, leaf shape and orientation, branch angle, and bark roughness. Throughfall yield depends on canopy density (Bouten *et al*., 1992), rainfall amount and intensity (Weiqing *et al*., 2007), wind direction (Herwitz and Slye, 1995) *etc.*

In this study, effect of six treatments *i.e*. vegetative barrier of *Panicum maximum*, staggered trenches, stone mulch, guava+pasture, sole guava and sole pasture for conserving *in-situ* soil moisture were studied in guava based hortipasture system for optimizing and sustaining guava and pasture production. The source of water for conserving *in-situ* into soil by those techniques is the net rainfall from guava tree and overland runoff. The objective of the paper is to estimate the amount of water that can be conserved directly in soil coming from net rainfall and study the effectiveness of different *in-situ* moisture conservation techniques in conserving in-situ soil moisture.

Materials and Methods

The throughfall and stemflow from four guava trees were measured during 20th August to 11th September, 2014 at guava based hortipastural block at Central Research Farm, Indian Grassland and Fodder Research Institute IGFRI, Jhansi, India. A standard non-recording type rain gauge was installed in open space nearby the study site to measure the rainfall. All the data were recorded during daytime. It was assumed that when one rainfall spell stopped and at least for next one hour there was no rain, considered as one exclusive rainfall event. Five buckets were kept randomly under each tree for measurement of throughfall. Average volume of throughfall calculated for each rainfall event from those buckets. Collar made of plastic funnel was used to trap and measure stemflow coming down the plant bole. The contact area between the plant and funnel is sealed with the help of adhesive and sellotape. Before fitting the funnel with the plant, a hole was made at the bottom side of the cut funnel to connect a pipe with one end at the funnel and the other with a clean plastic container for collecting the stemflow water. In this way, stemflow volume was measured for each rainfall event from each tree. The average SF, TF and I were calculated from four guava trees for each rainfall event. Interception loss was calculated after subtracting throughfall and stemflow depth from incident rainfall. After the end of monsoonal rainfall in September, monthly soil moisture in 0-15 cm and 15-30 cm soil profile was recorded from October, 2014 to February, 2015 in each treatment using gravimetric method.

Results and Discussion

Total 11 rainfall events were analysed for estimation of net rainfall during 20th August to 11th September, 2014. The minimum and maximum rainfall recorded during the study period was 0.35 mm and 4.63 mm respectively. Volume of SF, TF and I corresponding to each rainfall event is shown in Fig 1. All rainfall partitioned components increases with the increase of rainfall amount. Results showed that the proportion of rainfall partitioned components are in the following order TF>I>SF. It was also found that average TF, I and SF was 69.57%, 27.91% and 2.53% of incident rainfall. Therefore, the net rainfall (TF+SF) was 72.09% of the incident rainfall. Hence, whenever rainfall occurs on guava trees, on an average, 72.09% of the rainfall reaches to ground. Results also showed that a considerable part of rainfall does not reach to ground *i.e.* canopy interception and lost by the process of evaporation. It has been observed from the soil moisture data that staggered trench was most efficient in conserving in-situ soil moisture and it followed the order as staggered trenches>vegetative barrier>sole guava>sole pasture>stone mulch>guava + pasture (Fig. 2). The reason can be attributed to highest efficiency of staggered trenches in conserving in-situ soil moisture due to its orientation across the field slope. Hence, it intercepted and harnessed maximum of overland flow and net rainfall.

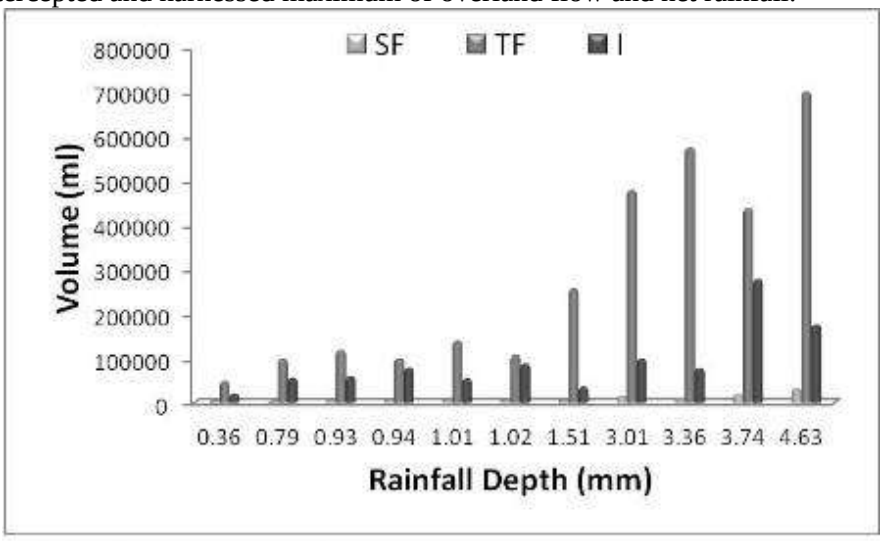

Fig 1 Variation of SF, TF and I with respect to rainfall

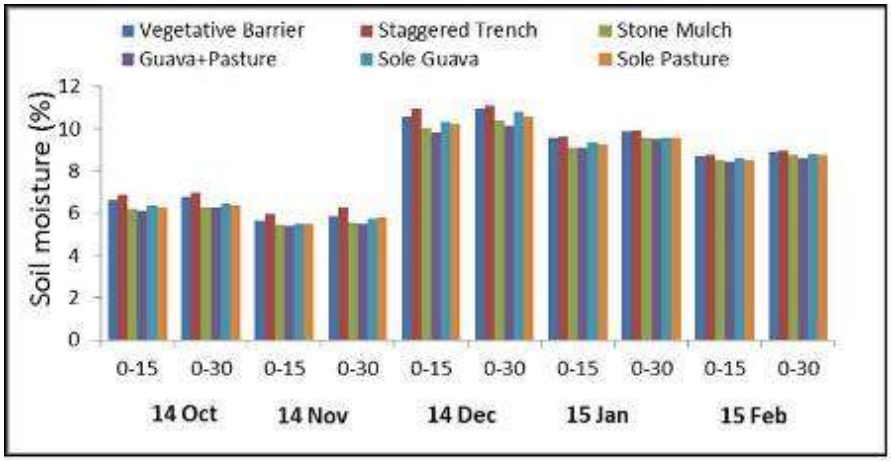

Fig 2 Temporal variation of soil moisture content in different soil moisture conservation techniques

Conclusion

The soil moisture conservation techniques are established for conserving soil moisture and to increase moisture availability to plants for longer period. In this study, one of the sources of water that is conserved in soil in-situ by these techniques i.e. net rainfall is quantified. Net rainfall amount depends on the quantity of the incident rainfall. About 72% of the incident rainfall reaches to soil and rest amount of the incident rainfall is lost by the process of evaporation. Among the soil moisture conservation techniques, staggered trench was found most efficient in conserving in-situ soil moisture.

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