

Infiltration Characteristics of Red sandy loams Under different Land use systems

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ABSTRACT: A study was conducted in Agroforestry Research Unit, Hyderabad. Andhra Pradesh to analyze the impact of different land use systems on infiltration characteristics through their effect on soil aggregation. The results revealed that infiltration rates were of moderate nature in all the systems, highest being in agri-silvi-horti system (6 cm h^{-1}). Cumulative infiltration, however, was highest with silvi-pasture system (17.33 cm) followed by agri-silvi-horti system (17-16cm). Both infiltration rate (2.2 cm h^{-1}) and cumulative infiltration (6.83 cm) were lowest in uncultivated land where in degree of aggregation was also lowest. The degree of aggregation in terms of aggregates $> 0.25 \text{ mm}$ and mean weight diameter were significant.

Keywords: Land use system, infiltration rate, cumulative infiltration, soil aggregation.

Red sandy loam soils (Alfisols), which cover a large area in Andhra Pradesh become very hard on drying due to low clay, low organic matter and presence of free iron oxides. Soil structure is also very poor in these soils and are prone to runoff and erosion. Optimum infiltration rate is a prerequisite for efficient water management, so as to enable the vegetation either annual or through perennial crops to give high productivity under rainfed conditions. As several trees in combination with pastures or arable crops add enormous amount of litter, soils adopting the practice of growing trees and agroforestry can be suggested for improvement of soil structure through aggregation (Kukul and Manmeet Kaur, 2003). It creates ultimately congenial physical environment. Therefore, in order to assess the impact of practicing agroforestry in such soils, the studies were taken up which would to go long way in choosing appropriate trees/tree systems to record optimum infiltration rate.

Material and Methods

A study was conducted on the "Effect of different agro-forestry systems on infiltration characteristics in rainfed Alfisols" in May 2003 in Agro forestry research unit, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad. The mean maximum and minimum temperatures were 35.3 and 19.3°C in the study area. Average annual rainfall was 768 mm . Agridultural and Fallow lands were selected from the adjacent students' farm. Rajendranagar is located at an

altitude of 542.6m above MSL and at $78^\circ 19' \text{N}$ latitude. The data was analysed statistically using RBD (Snedecor and Cochran, 1980).

The studies were made under different agro forestry systems as detailed below:

- Fallow land (uncultivated, virgin land)
- *Leucaena Leucocephala*
- Agriculture land
- *Eucalyptus camaldulensis*
- Agri-horti system
- *Acacia albida*
- Agri-silvi-horticulture
- *Azadirachta indica*
- Silvi-pasture
- *Tectona grandis*

All the systems were of 15 year old. All pure tree systems were planted at a spacing of 4×4 excepty in *Azadirachta indica* where in, it was planted at spacing of $5 \times 5\text{m}$. the details of tree species and inter crops grown are given below.

- **Agri-horti** – *Annona squamosa* based with cowpea as intercrop.
- **Agri-silvi-horti** – Tamarind based system, with filler bushy trees as curry leaf and custard apple, and sorghum as intercrop.

- **Silvi-pasture-** *Acacina nilotica* as tree and *Stylosanthes hamata* and *Cenchrus ciliaris* as pasture.

Infiltration rates were measured *in situ* in between the tree rows with double ring infiltrometer. Cumulative infiltration was estimated as suggested by Bertrand (1965). Soil profile samples from 0-15, 15-30, 30-45 and 45-60 cm layers were collected from different agroforestry systems in the month of May 2003. Soils were air dried and aggregates >8 and <5 mm diameter were used for wet aggregate analysis (Blake and Hartge, 1986). Aggregates >0.25 mm and mean weight diameter (MWD) were calculated from the wet aggregate analysis data using the following formulae, as indices of aggregation.

$$MED = \sum_{i=1}^n d_i w_i$$

Where n, is number of size fractions (the finest fraction that passes through the finest sieve inclusive i.e. <8 mm). d_i is the mean diameter of each size range, w_i is the weight of aggregates in that size range as a fraction of the total dry weight of the sample (W) analysed.

$$\% \text{ Aggregates } > 0.25\text{mm dia} = \frac{\text{weight of aggregates } > 0.25\text{mm dia}}{\text{weight of the soil}} \times 100$$

Results and Discussion

Infiltration

The data presented in table 1 revealed that up to 120 minutes the highest infiltration rate was recorded in agri-horti system (6 cm h^{-1}) and lowest was observed in fallow land (2.2 cm h^{-1}). In general, all the systems showed maximum infiltration in the first 10 minutes which could be because of high gravel content in the surface layer. Thereafter, there was steep fall in infiltration rate (fig. 1).

The infiltration rates recorded under agricultural land, *silvi-pasture*, *agri-silvi-horti Eucalyptus camaldulensis*, *Leucaena leucocephala*, *Acacia albida* *Azadirachta indica* and *Tectona grandis* were, 2.8, 5.5, 4.0, 3.6, 4.5, and 3.1 cm h^{-1} , respectively. Though all values fall under the same category *i.e.*, moderate (2.0 to 6.3 cm h^{-1})

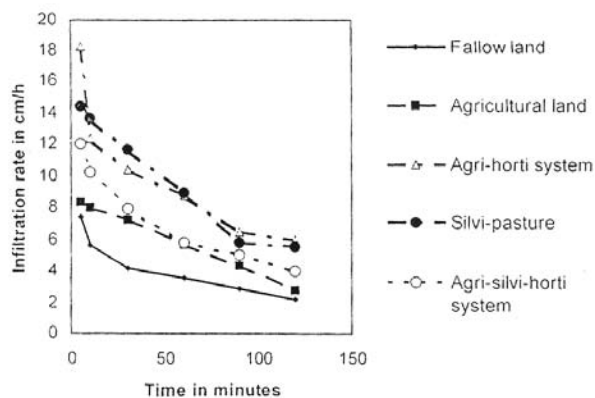


Fig. 1a. Infiltration rate under different land use systems

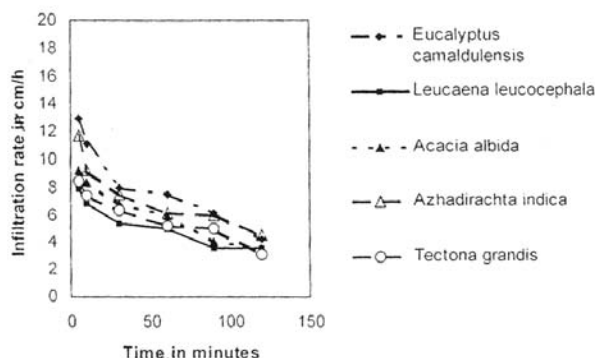


Fig. 1b. Infiltration rate under different land use systems

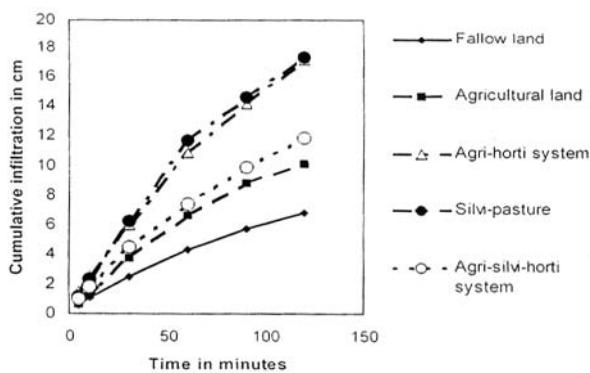


Fig. 2a. Cumulative infiltration under different land use systems

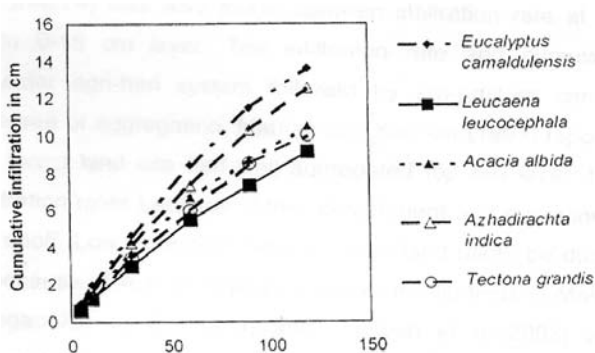


Fig. 2b. Cumulative infiltration under different land use systems

Table 1. Effect of different land use systems on soil aggregation and infiltration.

Land use system	% Aggregates > 0.25 mm					MWD (mm)			Infiltration rate (cm h ⁻¹)	Cumulative infiltration (cm)
	0-15	15-30	30-45	45-60	0-15	15-30	30-45	45-60		
Fallow land	20.86	19.3	17.71	16.63	0.64	0.63	0.60	0.5	2.2	6.83
Agricultural land	37.50	36.40	35.89	35.2	1.35	1.31	1.29	1.26	2.8	10.16
Agri-horti system	59.5	57.4	53.2	52.32	2.12	1.91	1.88	1.76	6.0	17.16
Silvi-pasture	56.4	52.85	50.1	48.23	1.96	1.88	1.83	1.79	5.5	17.33
Agri-silvi-horti system	52.78	50.6	47.23	46	1.92	1.82	1.76	1.71	4.0	11.88
Eucalyptus camaldulensis	48.35	45.54	40.23	39.35	1.89	1.80	1.75	1.73	4.2	13.63
Leucaena leucocephala	50.35	49.3	46.2	43.48	1.90	1.89	1.74	1.72	3.6	9.13
Acacia albida	50.12	48.40	47.23	40.44	1.86	1.82	1.80	1.78	3.6	10.53
Azhadirachta indica	41.20	39.90	36.83	33.31	1.62	1.45	1.32	1.20	4.5	12.59
Tectona grandis	42.82	40.82	39.00	34.24	1.78	1.59	1.41	1.23	3.1	10.08
CD at P=0.05	2.52	2.21	2.15	2.01	0.05	0.03	0.02	0.02	-	-

h^{-1}) impact of different land use systems was evident. Cumulative infiltration was highest (17.33 cm) in sivi-pasture followed by agri-horti system (17.16) and lowest (6.8) was observed in fallow land. Cumulative infiltration as a function of time under different land use systems is presented in fig. 2.

Degree of aggregation

In support of the findings on infiltration rate in different agroforestry systems, the degree of aggregation recorded in agri-horti system was (59.5% and 2.12 mm) followed by silvi-pasture (56.5% and 1.96 mm) in surface layers, which were 20.86% and 0.64 mm in case of fallow land (Table 1). Broadly, Significant differences in per cent aggregates of > 0.25 mm size and MWD were observed through out the profile in different land use systems, the differences were not significant in surface layer.

The correlation between the infiltration rate at 120 minutes and percent aggregates > 0.25mm in 0-15 cm layer was highly significant with r value of 0.82. Correlation ($r=0.74$) was also found between infiltration rate at 120 minutes and MWD in 0-15 cm layers. The infiltration rate and cumulative infiltration recorded under agri-horti system followed by sivi-pasture can be attributed to higher degree of aggregation. Mathan and Kannan (1993) reported that the profile under forest land use had well aggregated top soil layer, thus resulting in higher infiltration rates because of less detachment and migration of soil particles through runoff. Low infiltration rates in fallow land might be due to poor structure of soil because of lack of vegetation as per the findings of Mathur *et al.* (1982), Ambegaonkar *et al.* (1984) and Ramesh *et al.* (2003) who advocated the role of vegetation in improving the infiltration characteristics.

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