'INFILTRATION'- A MULTI FACTOR PHENOMENON

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ABSTRACT

To understand the complex phenomenon that infiltration is, experimental studies were conducted with treatments of tillage, manure application, vegetative growth and root development of coconut trees. It is gathered, that these treatments enhance the infiltration rates. Suitable soil management conclusions are arrived at.

Key Words : Infiltration multi factor phenomenon.

The present agricultural production, is around 165-175 million tonnes. The production is little more than one tonne. However, from irrigated, the potential yield expected is about 4 to 5 tonnes and from the dryland 1 t/ha. But these pleasant expectations are not realised due to many reasons.

The success or failure of a crop depends on the quantum and periodic availability of the sub-soil moisture. It is the infiltration that serves as a vehicle of carrying moisture or water from the rain into the subsoil porous reservoirs. Studied in the experiments and reported herein are the effects of tillage, fertilizer application, stages of plants and their roots.

MATERIALS AND METHODS

Effect of Tillage:

The resistance to infiltration through soil medium is governed by the tortuous porous passages available in the soil. Studies conducted by Meyer and Mannering (1960), Mannering et al. (1966), Burwell and Larsen (1969), Steichen and Nail (1980) go to show that the soil resistance is very much minimised due to tillage operations with chisel plough, mould board plough and disc plough. The bulk density of the soil is found to be decreased due to expansibility of soil volume under tillage. To confirm this effect of ploughings, investigations were made. With a mould board plough, two ploughings were given to the soil of a 50 cents field and this was followed by one run of harrowing. The depth of ploughing was about 25 cm. A portion of the field was formed control and infiltration was measured. The moisture contentS of the soil were 14.3 % and 13.7 %.

Effect of farmyard manure and chemical fertilizers:

To quantify this effect an experiment was taken with the application of farmyard manure at the rate of 10t/ha and a mixture of Urea (46 % N), Super Phosphate (16 % P) and Muriate of Potash (60 % K) at the rate of 70:35:35: in kg/ha. The infiltration rates were measured two weeks after the application.

Effect of vegetation:

The canopy of the vegetation would absorb the beating action of the rain drops while falling and help in the smooth arrival of rain drops on to the ground where the infiltration is to take place.

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Also in a densely canopy land the soil structure would be crumb due to organic matter addition and naturally the infiltration would be enhanced.

Earlier studies were made in this regard in grass cultivated fields by Williams and Doneen (1960), Muszarak *et al.* (1960). However in the study reported herein a cotton crop was raised and infiltration was observed in the infiltrometer ring driven circumscribing the plant and water was poured gently inside the ring. The above effects of canopy not be present but the root effect of the plant could play a role on the infiltration rate.

Root effect:

To study the exclusive effect of root, coconut was chosen. The infiltrometer rings were installed at a distance of 3m from the plant and observations made. The control plot was chosen at a distance of 40 m and the infiltration readings were observed.

The initial infiltration rate (Table 1) provides an important clue in respect of moisture conservation in dryland agriculture. It is prudent to give 2 or 3 ploughings to the soil during the presowing period so that the benefits of the rain is realised by an increased moisture storage in the soil. The surface crust of the soil formed at the time of ploughing besides the increased porosity help in infiltration by creating surface undulations and giving an enhanced opportunity for the water to be in contact with the soil.

The infiltration rate was higher in the manured plots. Similar results were obtained by Cross and Fischback (1973). Evidently the increased rate of infiltration was due to favourable soil structure as modified by the manure and the chemical fertilizer.

The infiltration rate was higher in vegetative stage, maturity and flowering and harvest stages than in the establishment stage (Table 2). There was a tendency of increased infiltration in the treatment when compared to the control.

As may be seen from Table-1, the roots of the coconut could increase the infiltration rate 2 to 2.5 times when compared to the control.

Prediction equations for infiltration:

Normally three types of equations viz., (1) Kostiakov-Lewis equation (2) Horton's equation and (3) Philip's equation are fitted to the ex-

Table 1: Effect of Tillage, farmyard manure, chemical fertilizer and coconut root intrusion on infiltration.

Elapsed time (min)	Infiltration rate in cm/hr				
	Control	Tillage	Farmyard manure	Chemical fertilizer	Coconut root intrusion
0	-	-	-	-	-
2	-	42.0	-	45.0	36.0
5	15.6	14.4	15.6	13.2	12.0
10	6.0	12.0	6.0	8.4	10.8
20	4.2	6.0	3.6	4.2	6.0
35	2.0	5.6	3.2	2.4	4.8
65	1.4	4.8	2.8	1.4	4.4
125	0.5	4.4	1.7	1.2	3.0
185	0.4	4.0	1.6	1.0	2.5
245	0.3	3.8	1.2	0.5	2.2
305	0.3	3.3	1.2	0.5	2.0
365	-	3.0	-	-	2.0
425	-	2.5	-	-	-
485	-	2.5	-	-	-

Table 2. Effect of crop stages on the infiltration rate (cotton)

Elapsed time (min)	Infiltration rate in cm/hr				
	Control	Establishment stage	Vegetative stage	Maturity & flowering	Harvest stage
0	-	-	-	-	-
5	15.3	18.0	39.6	37.2	19.2
10	6.9	4.8	13.2	12.0	7.2
20	4.0	1.8	4.8	6.0	5.4
35	2.4	1.6	3.2	2.8	2.8
65	1.6	0.6	2.2	1.8	1.8
125	1.0	0.4	1.3	1.1	0.8
185	0.8	0.4	0.8	0.8	0.7
245	0.5	0.4	0.6	0.6	0.6
305	0.5	-	0.6	0.6	0.6

perimental data in order to arrive at prediction equations. For the data at hand Kostiakov-Lewis equation seems to give a better fit as the coefficient of correlation is higher at -0.964 to -0.995. The equations fitted for the different treatments as per Kostiakov-Lewis equation are:

1. $f = 38.075 \, t^{-0.889}$ (Control)
2. $f = 31.557 \, t^{-0.426}$ (Tillage)
3. $f = 18.084 \, t^{-0.493}$ (Farmyard manure)
4. $f = 45.142 \, t^{-0.817}$ (Fertilizer)
5. $f = 31.238 \, t^{-0.501}$ (Coconut tree)
6. $f = 59.799 \, t^{-0.851}$ (For cotton crop later 3 stages)

Where, f is the instantaneous infiltration rate in cm/hr and

t is the elapsed time in minutes.

It is inferred from the studies that summer ploughing in the presowing period in dry lands would help in preserving more moisture as evidenced by the infiltration rates. Application of manure followed by irrigation helps in better moisture conservation. The conclusions can be adopted as managerial strategies in dryland and irrigated agriculture.

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