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Performance of different filter (envelope) materials in subsurface drainage system

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The field experiment was conducted to study performance of different filter (envelope) materials in subsurface drainage (SSD) system. The results revealed that the water table decline, drain discharge, drainage coefficient and hydraulic conductivity were maximum, whereas EC and SAR of drain water were lowest in SSD system with coarse sand filter over SSD system with coarse sand + nylon sleeve and nylon sleeve alone

Key words: Subsurface drainage, Filter materials, Water table, Drain discharge, Drainage coefficient, Hydraulic conductivity.

INTRODUCTION

FAILURE of subsurface drains is a frequent problem mainly in non cohesive soils and in area with higher water table at the time of installation. This creates the necessity of providing some measures to protect the drain from soil particle entry. The placement of porous materials around the drain will out soil particles allowing only clean water to enter the drainage system, thus, the preventing the problem of sedimentation and reduction of capacity .It was stated that most dangerous soil particles, with regard to their silting tendency, are in the range of 0.05 to 0.15 mm .The smaller than 0.05mm would be carried away by drainage water.

The function of envelope materials is not only to protect the pipe drain from silting up but also to reduce the entry resistance. The perforated corrugated PVC drainage pipes are not completely pervious; their perforated area occupies only 1-2 % of total pipe surface. Compared to flow towards on ideal, commercial drain cause an extra head loss due to flow concentration towards the isolated inlet opening. This flow produces an extra resistance, which is known as entrance resistance. Drain filter material reduces the entrance resistance and improves the effectiveness of the system. (Willardson, 1987and Stuyt,1989).

Broughton (1976) and Broad head et.al. (1983) conducted experiments to evaluate the performance of different synthetic filter materials in order to study the effects on silting up the drain pipes.

Granular material such as graded coarse sand and fine gravel, is widely used in semi-arid and arid regions, it provides an effective and durable filter if available at reasonable cost and if proper installed. Now a days synthetic filter materials are available world wide and accepted due to its cost factor and ease of installation without considering the effectiveness of filter materials. Therefore, the present investigation is aimed to study the performance of different filter (envelope) materials in subsurface drainage (SSD) system.

MATERIALS AND METHODS

The field experiment was conducted to study performance of different filter (envelope) materials in subsurface drainage (SSD) system. The subsurface drainage system was installed on farm with corrugated perforated PVC pipes on 8.81 ha of salt affected soils at Agril. Research station K. Digraj Dist-Sangli (M.S.) in December, 2002. The experimental soil status of salt affected soil was pH-8.13 to 8.52, EC 2.22 to 17.82 dS/m, ESP 7.04 to 17.50. The hydraulic conductivity was in the range of 0.0236 to 0.0579 m/day. The water table of fluctuations recorded was in the range of 0.265 to 1.85 m from the surface in different seasons. Perforated corrugated PVC pipes of 80 mm diameter were used for lateral drains and non perforated corrugated PVC pipes of 80 mm diameter were used for collector drain. The average depth of collector and lateral drains was 1.32 m. The spacing between two laterals was 25 m. The drain spacing of 25-100 m horizontal subsurface drainage requirements for waterlogged saline soils studied at Sampla and other places in Haryana (Gupta,1985,Rao ,et.al.,1986).Coarse sand, nylon sleeve filter and Coarse sand+ nylon sleeve was used as filter envelope. For measurement of water table fluctuation, piezometer were installed at S/O (30 cm away from lateral), S/2 (12.5 m away from lateral), S/4 (6.25m away from lateral) and S/8(3.125 m away from lateral) on both sides of the chosen laterals for each filter material. The drain discharge, drainage coefficient and water level were recorded three days after irrigation for the year 2004-05. An entrance head loss (h_e) were computed by subtracting the depth of water table (30 cm away from lateral) from the average drain depth . While the total loss of hydraulic head (h_{tot}) were computed by subtracting the depth of water table (12.5 m away from lateral) from the average drain depth. The head loss fraction were calculated by, ho =(h_e)/ (h_{tot}) .The hydraulic conductivity were determined by single auger hole method. The drain water from different laterals with different filter materials was analysed for salinity and sodicity parameters.

RESULTS AND DISCUSSION

1) Effect of different filter materials on water table fluctuations:

The water table fluctuations were recorded three days after irrigation from Table 1 that the water table in nylon sleeve was 44.4 to 45.4 cm at S/2 and 91.5 cm at S/0. The water table in coarse sand filter were 73.4 cm to 76.2 cm at S/2 and 120.0 cm at S/0 , whereas, 51.1cm at S/2 and 111.7cm at S/0 in nylon sleeve +coarse sand filter. It is revealed that the SSD system with coarse sand filter gave the better results to lower down the water table.

2) Effect of different filter materials on drain discharge, drainage coefficient and hydraulic conductivity of soil

The drain discharge in nylon sleeve, coarse sand filter and nylon sleeve + coarse sand filter was 3714, 7087 and 4932 litres/day respectively (Suryawanshi et.al 1985). While the drainage coefficient in nylon sleeve, coarse sand filter and nylon sleeve + coarse sand filter were 0.371, 0.709 and 0.495 mm/day respectively. The hydraulic conductivity of soil in nylon sleeve, coarse sand filter and nylon sleeve + coarse sand filter were 0.034, 0.043 and 0.04m/day respectively (Table 2). It is revealed that drain discharge, drainage coefficient and hydraulic conductivity were recorded highest in coarse sand filter over

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Table 1 : Effect of SSD with different filtering material on water table fluctuations (3 days after irrigation)

Sr. No.	Treatments	W. T. depth(cm) from soil surface, 3 days after irrigation						
		S/2	S/4	S/8	S/0	S/8	S/4	S/2
1.	Nylon sleeve	45.4	52.3	62.1	91.5	60.8	51.8	43.4
2	Coarse sand filter	73.4	85.2	93.5	120.0	93.3	84.1	76.2
3	Nylon sleeve + coarse sand filter	51.2	57.3	74.4	111.7	71.8	58.5	51.1

Table 2 : Drain discharge, Drainage coefficient and Hydraulic conductivity of soil

Treatments	Drain discharge (litres/day)	Drainage coefficient (mm/day)	Hydraulic conductivity (m/day)
Nylon sleeve	3714	0.47	0.0340
Coarse sand filter	7087	0.71	0.0435
Nylon sleeve + Coarse sand filter	4932	0.50	0.0400

Table 3 : Entrance head loss, head loss fraction and drain line performance

Treatment	Entrance head loss(m)	Head loss fraction	Drain line performance
Nylon sleeve	0.400	0.89	Poor
Coarse sand filter	0.120	0.163	Good
Nylon sleeve + Coarse sand filter	0.203	0.4	Moderate

Table 4 : Chemical properties of drained water

Treatments	pH	EC(dS/m)	SAR
Nylon sleeve	7.45	12.45	11.85
Coarse sand filter	7.67	3.16	3.33
Nylon sleeve + Coarse sand filter	7.66	3.26	4.58

nylon sleeve alone and nylon sleeve + coarse sand filter.

3. Performance of lateral drains with different filtering materials

According to the data presented Table 3, It can be seen that the entrance head loss in coarse sand filter was less than 0.15 and the head loss fraction was less than 0.2. As per FAO (1972) rating this comes under good performance .The nylon sleeve recorded poor performance, whereas nylon sleeve + coarse sand filter were recorded moderate performance.

4.) Effect of different filtering materials on chemical properties of drained water

The EC and SAR of drained water were recorded lowest in coarse sand filter over all other treatments (Table 4). Therefore the improvement of salt affected and waterlogged soil is rapid in coarse sand filter over nylon sleeve and nylon sleeve + coarse sand filter.

The results thus showed that the subsurface drainage system with coarse sand filter provided the best result for clayey soil.

REFERENCES

Broadhead, R.C., Schawab, G.O. and Reeve, R.C. (1983). Synthetic drain envelopes and particle size distribution.Trans, ASAE,26(1): 157-160.

Broughton, R. S. (1976). Tests on filter materials or plastic drain tubes. Proc, Third National Drainage Symp. ASAE (Pub.1) 77:34-39.

Gupta,S.K. (1985). Subsurface drainage for waterlogged saline soils. *Irrig.Power,J.*42:335-44.

Rao,K.V.G.K.Singh,O.P.Gupta,R.K.Kamra, S.K.Pandey, R.S.Kumbhare, P.S.andAbrol, I.P. (1986). Drainage investigations for salinity control in Haryana .Bull.No.10 CSSRI, Karnal pp95

Stuyt, L.C.P.M. (1989). Drain envelope research Project. Confidential report 1985-1988.Part:text (67 pp)

Suryawanshi,S.N.,Sawant M.M. and Pamapattiwar,P.S. (1985). Subsurface drainage for water table control and sustained agricultural production: case study. Paper presented at seminar on water management Technology Transfer, GBPUAT, Pantnagar. 2-4 may 230-42.

Willardson, L.S. (1987). Drain envelope drainage design and management, Proceeding of the fifth National Drainage symposium. American Society of Agricultures Engineers Publ.07-87. St Joseph Michigan USA, 13-18