Effect of Compactions on Infiltration Characteristics of Soil

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Abstract: The field research was conducted at Sindh Agriculture University, Tandojam, Pakistan. The treatments were soil compactions (uncompacted, 5 and 10 times compacted soil) and their effect on water infiltration rate in silt loam soils. It was observed that infiltration rate was higher during initial irrigation application, but, gradually reduced and became constant when the soil was saturated. The bulk density of uncompacted, 5 and 10 times compacted soils was recorded as 1.13 to 1.20, 1.19 to 1.29 and 1.19 to 1.32 g/cc, respectively at 0 to 90 cm soil profile. The infiltration rate was higher (17.10 mm/hr) in the uncompacted soil compared to those 5 and 10 times compacted soils (13.89 and 9.78 mm/hr) respectively. The increased infiltration rate in the uncompacted soil was mainly due to soil porous medium having low bulk density values.

Key words: Infiltration-silt, loam soil, soil compactions

Materials and Methods
The field experiments were conducted at Sindh Agriculture University, Tandojam, Pakistan. The treatments were the effect of compacted and uncompacted soil types on infiltration rate of water. The compacted soils were prepared by Ford-6610 tractor wheels (5 and 10 times compacted than uncompacted soil). The textural class of the soil was silty loam. The average bulk density of the uncompacted soil was 1.19, 1.15, 1.17, and 1.20 g/cm² at 0-15, 15-30, 30-60, and 60-90 cm soil depths, respectively. The bulk density of five and ten times compacted soil was 1.27, 1.22, 1.18, and 1.28 g/cm² at 1.32, 1.27, 1.20, and 1.19 g/cm², respectively at above mentioned soil depths. The infiltration rate of the soil was identified by the double ring infiltrometer by following procedure: Buffer cylinder was installed in the soil with the help of big driving plate and hammer. Intake cylinder was installed with the help of small driving plate with hammer. Both the cylinders were leveled and then checked with the help of spirit level. Hookgauge was fixed in intake cylinder. Straws were used as puddling protection device into the intake cylinder before putting water into the cylinder. Straws were removed from the intake cylinder after filling with water. Digital watch was used for time recording, initial time and initial hookgauge readings were taken simultaneously. Initially hookgauge readings were checked after every five minutes, after thirty minutes, after another seventy minutes. After passing one hundred thirty minutes the hookgauge readings were taken after every thirty minutes. The elapsed time was taken from time readings, and accumulated depth was taken from hookgauge readings. The equation selected for determining infiltration was: \[
\text{I} = \frac{D}{T} \times 60
\]

where \( I \) = average infiltration rate (mm/minute), \( D \) = Accumulated depth (mm), and \( T \) = Elapsed time (minutes).

Results and Discussion
The infiltration rate in the uncompacted silt loam soil was higher in all three tests (17.84, 16.42, and 17.05 mm/hr) respectively by recording an average value of 17.10 mm/hr in three hours (Table 1). The average infiltration rate in 5 and 10 times compacted soil was 13.89 and 9.78 mm/hr, respectively (Table 1) which was quite lower compared to uncompacted soil. The field for higher intake in uncompacted profile was due to the low bulk density of the soil, ranging from 1.13 to 1.20 g/cc where porosity was high which allowed water to penetrate soil profile easily, whereas in 5 and 10 times compacted soil profiles, the bulk densities

Table 1: Average infiltration rate of uncompacted, 5 and 10 times compacted silt loam soil

<table>
<thead>
<tr>
<th>Nature of soil</th>
<th>Test No.</th>
<th>Infiltration Rate (mm/hr)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncompacted soil</td>
<td>1</td>
<td>17.84</td>
<td>17.10</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>16.42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>17.05</td>
<td></td>
</tr>
<tr>
<td>5 times compacted soil</td>
<td>1</td>
<td>13.89</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>13.42</td>
<td>13.89</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>14.36</td>
<td></td>
</tr>
<tr>
<td>10 times compacted soil</td>
<td>1</td>
<td>9.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10.42</td>
<td>9.78</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>9.15</td>
<td></td>
</tr>
</tbody>
</table>
were higher 1.19 to 1.29 and 1.19 to 1.32 g/cc, respectively at 0 to 90 cm soil profile. The results agree with the findings of Oad et al. (2001) who concluded that the intake rate was badly affected by swelling of soil particles, and porosity of the soil. Thus compacted soils exhibited lower intake rate as compared to uncompacted soil profiles. Further, it was observed that initially when the soil was dry, the infiltration rate was also higher. FAO (1988) also reported similar findings and expressed that the infiltration rate takes place most rapidly when the water is first applied to the soil, but as the topsoil becomes saturated, the swelling of the clay is caused and hence, the infiltration gradually becomes constant (Donen and Westcot, 1988; McNeal and Coleman, 1973). The decrease in infiltration rate with time is mainly due to the depth of wetted zone.

References
U. S. Salinity Laboratory Staff, 1954. Diagnosis and Improvement of Saline and Alkali Soils, Agric. Handbook No.60. USDA Washington, D. C.