DETERMINATION OF ROOT DISTRIBUTION IN POMEGRANATE 
BY ROOT EXCAVATION TECHNIQUE

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ABSTRACT
Distribution of various types of roots at different radial distances and depths was studied using
the root excavation technique in four year old pomegranate trees. The distribution of root pattern
was influenced by the distance from tree trunk, soil depth and the season of excavation. It was
recorded that root density was found maximum at nearest radial distance from tree trunk i.e. 0-60
cm (83.77 % and 83.29 % during post rainy and spring season, respectively) and an increase in
distance from the tree trunk resulted in reduction of root density considerably. During post rainy
season, roots were found maximum at 0 to 25 cm followed by 25 to 50 cm and 50 to 75 cm soil
depths. Same results obtained in spring season. The feeder roots were recorded higher in post rainy
season compare to spring season.

Key words:- Feeder root, Fibrous root, Radial distance, Root excavation, Spring season.

The knowledge of root distribution pattern is very helpful in allocating inputs like fertilizers and
irrigation. It has been experimentally proven that root distribution pattern varies from region to region and
is influenced by such factors as age of plant, season of the year, plant species, fluctuation in water table
and properties of soil (Ford, 1954; Kolesnikov, 1971; Mellado and Caballero, 1974). The excavation
methods was time consuming and labour intensive but it was widely used for the study of root
distribution patterns in fruit plant. Root excavation methods are mechanically simple and require
instruments which are ordinarily available at the site of the experiments. An experiment was undertaken
to study the rooting pattern of aonla trees by root excavation methods. There are reports available on
determination of rooting pattern by root excavation in citrus (Chandra and Yamadagni, 1983 and
Chandra and Yamnadagni, 1997) at Hisar and in ber by Pareek (1977) in arid region of Rajasthan.

Experiments were carried out on four year old trees of pomegranate during post rainy (October,
2009) and spring season (March, 2010) at farmer’s orchard in Bhiliyakhedi village in Chittorgarh district
of Rajasthan. Four uniform trees were selected for excavation. The pomegranate trees were prepared
by cutting. In each experimental tree of pomegranate, a circle with a radius of 1.80 meter
from the tree trunk was marked and soil was excavated from 1/8th portion of the area of the circle.
The 1.80 meter was further divided into 0-60 cm (R₁), 60-120 cm (R₂) and 120-180 cm (R₃) portions.
Each portion was excavated for three depths viz., 0-
25cm (D₁), 25-50 cm (D₂) and 50-75 cm (D₃). The
data on vigour of experimental trees are given in
Table1. distance, separately and washed. After
washing the roots were graded in four categories on
the basis of their diameter. The roots were measured
by vernier callipers and then divided into four
categories, (i) less than 0.2 cm diameter (T₁), (ii)
0.2 cm to 0.5 cm diameter (T₂), (iii) 0.5 cm to 1.5
cm diameter (T₃) and (iv) more than 1.5 cm diameter
(T₄). These categories were designated as feeder,
thin, medium and thick, respectively.

The roots were kept in an oven at 70° C for
72 hours for drying and then weighed. The density
of roots on dry weight basis was calculated in terms
of per cubic meter volume of soil. The density of
roots on dry weight basis was obtained by multiplying
the quantity of dried roots (g) obtained at 0-60 cm,
60-120 cm and 120-180 cm radial distances in
pomegranate with 28.309, 9.452 and 5.663,
respectively. The distribution of roots on weight basis
at different radial distances and soil depths was
tested in factorial RBD experiment.
It is revealed from the data presented in Table 3 that during post rainy season at 0-60 cm distance from tree trunk significantly higher amount of roots (83.77 %) were found as compared to other distances from tree trunk. It is evident from the data that soil depth wise, maximum quantity of roots (87.47 %) were observed at D₁ (0-25 cm depth) and it was significantly higher than D₂ (25-50 cm soil depth) i.e. 8.02 per cent roots and D₃ (50-75 cm soil depth) i.e. 4.51 per cent roots. In case of radial distance, maximum amount of roots was found at R₁ (0-60 cm from trunk) i.e. 83.77 per cent of total roots which was significantly higher from R₂ (60-120 cm from trunk) i.e. 12.23 per cent and R₃ (120-180 cm from trunk) i.e. 4.00 per cent. The maximum quantity of roots (73.43 %) was recorded at 0-60 cm radial distance and 0-25 cm soil depth (R₁ x D₁) treatment combination which was significantly higher and followed by R₁ x D₂ and R₁ x D₃ treatment combination. Similar observations have been reported by Chandra and Yamdagni (1997) in Kinnow mandarin, Bhatnagar and Chandra (2001) in ber and Singh and Chandra (2009) in acid lime. The distribution of different types of roots at different radial distances is presented in Table 4. The result obtained from interaction between radial distance and types of roots reveal that at 0-60 cm radial distance (R₁), 0.5 to 1.5 cm diameter roots were found maximum (6.51 %) quantity, followed by 0.5 - 1.5 cm (5.63 %), < 0.2 - 0.5 cm (4.07 %) and > 1.5 cm (0.33 %). At 60-120 cm radial distance (R₂), 0.2 – 0.5 cm diameter roots were found maximum (1.29 %) followed by < 0.2 cm (0.59 %) and > 1.5 cm (0.00 %) diameter roots. It may be revealed that 0.5 - 1.5 cm diameter roots were recorded maximum (30.97%) quantity in 0 – 180 cm radial distance followed by < 0.2 cm diameter roots (29.05 %). Similar findings have been reported by Aiyappa and Srivastava (1965) in Coorg mandarin trees, Chandra and Yamdagni (1997) in Kinnow mandarin, Rohitash (2007) in aonla and Singh and Chandra (2009) in acid lime.

Data on the root distribution of pomegranate plants at different distances from the tree trunk and at different soil depths during spring season are present in Table 5. It is evident from the data that soil depth wise, maximum quantity of roots (86.46 %) were observed at D₁ (0-25 cm depth) and it was

### TABLE 1: Vigour of experimental trees of pomegranate at the commencement of root excavation.

<table>
<thead>
<tr>
<th>Plant height (cm)</th>
<th>Spread of tree (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>North to South</td>
</tr>
<tr>
<td>300</td>
<td>245</td>
</tr>
<tr>
<td>305</td>
<td>300</td>
</tr>
<tr>
<td>290</td>
<td>295</td>
</tr>
<tr>
<td>302</td>
<td>300</td>
</tr>
</tbody>
</table>

### TABLE 2: Relative proportions of sand, silt and clay (mechanical fractions %) at Bhiliyakhedi of pomegranate orchard.

<table>
<thead>
<tr>
<th>Soil depth (cm)</th>
<th>Sand(2.0 – 0.05 mm)</th>
<th>Silt(0.05 – 0.002 mm)</th>
<th>Clay &lt; 0.002 mm</th>
<th>Textured classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>15.65</td>
<td>56.37</td>
<td>27.98</td>
<td>Silty Clay Loam</td>
</tr>
<tr>
<td>15-30</td>
<td>16.98</td>
<td>50.93</td>
<td>32.09</td>
<td>Silty Clay Loam</td>
</tr>
<tr>
<td>30-60</td>
<td>18.07</td>
<td>52.04</td>
<td>29.89</td>
<td>Silty Clay Loam</td>
</tr>
<tr>
<td>60-90</td>
<td>15.11</td>
<td>61.29</td>
<td>23.60</td>
<td>Silt Loam</td>
</tr>
<tr>
<td>90-120</td>
<td>20.53</td>
<td>54.10</td>
<td>25.37</td>
<td>Silt Loam</td>
</tr>
</tbody>
</table>

### TABLE 3: Roots distribution at different radial distances from tree trunk and soil depths in pomegranate trees (g/m³ of soil volume) during post rainy season.

<table>
<thead>
<tr>
<th>Distance from tree trunk</th>
<th>Soil depth (cm)</th>
<th>0-25 (D₁)</th>
<th>25-50 (D₂)</th>
<th>50-75 (D₃)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-60 (R₁)</td>
<td>4626.73(73.43%)</td>
<td>410.48(6.52%)</td>
<td>240.63(3.82%)</td>
<td>1759.28(83.77%)</td>
<td></td>
</tr>
<tr>
<td>60-120 (R₂)</td>
<td>680.54(10.80%)</td>
<td>51.91(0.83%)</td>
<td>37.81(0.60%)</td>
<td>256.78(12.23%)</td>
<td></td>
</tr>
<tr>
<td>120-180 (R₃)</td>
<td>203.87(3.24%)</td>
<td>42.47(0.67%)</td>
<td>5.81(0.09%)</td>
<td>84.05(4.00%)</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1837.05(87.47%)</td>
<td>168.31(8.02%)</td>
<td>94.75(4.51%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SEm ± CD (0.05)
significantly higher from D$_2$ (25-50 cm soil depth) i.e. 8.56 per cent roots and D$_3$ (50-75 cm soil depth) i.e. 4.98 per cent roots. In case of radial distance, maximum amount of roots was found at R$_1$ (0-60 cm from trunk) i.e. 83.29 per cent of total roots which was significantly higher from R$_2$ (60-120 cm from trunk) i.e. 11.82 per cent and R$_3$ (120-180 cm from trunk) i.e. 4.89 per cent. The maximum quantity of roots (71.83 %) was recorded at 0-60 cm radial distance and 0-25 cm soil depth (R$_1$ x D$_1$) treatment combination which was followed by R$_1$ x D$_3$ and R$_1$ x D$_2$ treatment combination. The minimum density of roots (0.07 %) was recorded at R$_3$ x D$_3$ treatment combination. Data on distribution of different types of roots at different radial distances are presented in Table 6. The result obtained from interaction between radial distance and types of roots reveal that at 0-60 cm radial distance (R$_1$), 0.5 to 1.5 cm diameter roots found in maximum (21.76 %) quantity, followed by < 0.2 cm (16.06 %), 0.2 – 0.5 cm (9.43 %) and > 1.5 cm (8.13 %) at 60-120 cm radial distance (R$_2$), < 0.2 cm (10.97 %) quantity, followed by 0.2-0.5 cm (9.43 %) and > 1.5 cm (3.17 %) at 120-180 cm radial distance (R$_3$).
At 120-180 cm radial distance ($R_3$) roots were found maximum (1.81 %) followed by < 0.2 cm (1.57 %), 0.2 - 0.5 cm (0.87 %) and > 1.5 (0.00 %) diameter roots. It may be revealed that 0.5 - 1.5 cm diameter roots were recorded maximum quantity (30.76 %) in 0-180 cm radial distance followed by < 0.2 cm diameter roots (28.60 %), 0.2 - 0.5 cm diameter roots (26.75 %) and > 1.5 cm diameter roots (13.90 %). Similar findings were recorded by Pareek (1977) in ber, Bhatnagar and Chandra (2001) in ber cv. Gola and Singh and Chandra (2009) in acid lime.

REFERENCES