Tomato Plant Growth

Influenced by Soil Compaction, Soil Moisture and Air Space

Soil moisture suction, mechanical impedance through alteration of the air spaces in the soil, or a combination of both factors can influence the growth of tomato plants.

Pots were rotated within the cabinets daily and, except for the watering procedures mentioned, nothing further was done to them. After six weeks, plants were harvested and weighed fresh. Pots were then sampled for moisture content and distribution of moisture.

In problems dealing with controlled soil moisture contents or air spaces it is imperative that ranges or extremes be known. The ranges were determined between irrigations for each pot from knowledge of the amount of water needed to return the pot to its original moisture content. These ranges, however, gave no information as to distribution of moisture or air spaces within a given pot. Therefore, at the conclusion of each run, soil cores were removed from two sides and the center of each pot and cut into thirds.

Moisture content was determined on each of these samples.

Graphs

The plant-soil-water-air relations obtained for the two soils are shown in the graph. The shape of the curve for each soil shows that both behaved similarly. The decrease in plant yields, corresponding to increases in bulk density at nearly constant air space, may be attributed to increasing soil suctions. The graphs also indicate that if the mean soil suction was maintained at about 0.7 to 1.0 bar, fresh weight yield was independent of bulk density provided air spaces were not limiting. At 14 per cent air space, fresh weight was dependent only on soil suction. At nearly constant suction, yields were not influenced by increasing density even

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**Tomato Plant Growth Parameters**

- **Air space**
  - In the first part of the experiment, the air space was kept at about 15 per cent by reducing the mean soil water content as soil density increased. It was also necessary to maintain the soil suction at higher levels for each increase in soil bulk density. The mean water content or suction was maintained by irrigating the pots twice daily with distilled water (at the beginning and end of the daytime 8 hours when water consumption was highest). One irrigation was added to the surface of the pot while the other was allowed to enter from the bottom. The amount of water needed for each irrigation was determined by loss of gross weight of the complete pot and attached equipment and also from tensiometers installed in the soil when moisture ranges permitted their use.

- **Soil suction**
  - In the second part of the experiment, the soil suction was maintained at about 0.5 bar. Therefore, soil air spaces necessarily decreased as soil density increased. Mean soil suction was maintained in the manner already described, by direct weighing and tensiometers. Twice-daily records were maintained of the quantity of water used. Water content was determined from the amount of water needed to return each pot individually to its original content.

- **Plant-soil-water-air relations**
  - Graphs 1 and 2 show the relationship between soil suction and fresh weight yield for Sorrento silty clay loam. Graphs 3 and 4 illustrate similar data for Salinas silt loam. The graphs indicate the importance of maintaining a constant air space and soil suction to optimize plant growth.
though air spaces varied from 32 per cent to about 10 per cent.

On the other hand, the decrease in plant yield may be attributed to mechanical impedance associated with high soil suctions. Fresh weight of plants was independent of bulk density levels at 0.7 bar soil suction. This may mean that soil strength was not sufficient to impede root growth. However, when mean air space was maintained at 15 to 16 per cent and soil suction increased from 0.1 to about 5.0 bars, soil strength may have increased sufficiently to restrict root growth and consequently affect the fresh weight of plants. Therefore, over these ranges of air spaces and for these two soils, soil suction or a combination of soil suction and mechanical impedance played the dominant role in reducing tomato yields.

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