Root Growth and Spatial Distribution Characteristics for Seedlings raised in Substrate and Transplanted Cotton

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Abstract

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Protocol

In both experiments in each year, the land was ploughed and irrigated in early spring before sowing. In all plots, 225 kg ha-1 N, 150 kg ha-1 P2O5 and 225 kg ha-1 K2O was applied. All of the fertilizers were broadcasted evenly across the soil and incorporated into the top 20 cm of the soil before sowing. Approximately 45 mm of supplemental water (per irrigation event) was added by flooding the furrows and according to the recommendations of local agronomists. Other field management strategies were used based on local agronomic practices. Weeds were manually controlled before plastic mulch being used and pesticides were used to control insects and diseases.

Step 1.

Substrate seedling transplanted cotton

Step 2.

Two cotton seeds were sown in each cavity of trays containing 100 cavities (60 cm*33 cm*5 cm)

Step 3.

Placed in greenhouse-like huts

Step 4.

Seedlings were transplanted into 10-cm-deep holes in field that were dug with a hand machine which was homemade

Step 5.

Soil-cube seedling transplanting system

Step 6.

Columned soil blocks (4-6 cm in diameter and 8-12 cm high), made of soil and fertilizer (N:15%, P2O5:15%, K2O:15%) with corresponding sizes of molds, were prepared before planting

Step 7.

The seeded soil cubes were placed neatly in seedling beds (10 cm deep and 2 m wide) in a greenhouse-like hut

Step 8.

One seed was sown in each block as soon as watering occurred

Step 9.

Blocks with seedlings were transplanted into 10-cm-deep holes manually in the experimental plots

Step 10.

Direct sowing systems with plastic mulching

Step 11.

Cotton seeds were covered with moist soil in all systems and mulched with wide plastic film (6 μm thick and 120 cm wide) that was held in place by burying its edges with soil along two rows

Step 12.

After emergence, holes were cut in the film to allow the seedlings to emerge

Step 13.

Root samples were collected once before each irrigation event (9 times) during each season

Step 14.

A soil core device (7 cm in diameter, 10 cm high) was used to obtain samples to minimize horizontal and vertical root damage.

Step 15.

To study the horizontal distributions of the roots, root cores (soil samples containing roots) were collected in two directions (east and west) from the trunk region (0 cm) of the plants at distances of 20 and 40 cm

Step 16.

To study the vertical root distribution, the auger was inserted to a depth of 120 cm from the soil surface.

Step 17.

The resulting soil core was divided into 12 blocks of 0-10 cm, 10-20 cm, 20-30 cm, 30-40 cm, 40-50 cm, 50-60 cm, 60-70 cm, 70-80 cm, 80-90 cm, 90-100 cm, 100-110 cm and 110-120 cm in both sampling directions, and the soil was removed carefully using hand implements from each block to a depth of 10 cm.

Step 18.

Each 10-cm-deep root core was placed in a 0.05 cm diameter circular grid mesh sieve and washed under running water to remove soil particles from the roots.

Step 19.

Collected root samples were scanned with a scanner (Phantom 9800X, MiCROTEK, Shanghai, China) and analyzed using the DT-SCAN software (Delta-T Devices Ltd, UK) to determine the root length (RL), average root diameter and root surface area (RA).

Step 20.

The root length density (RLD, root length per volume of soil, mm/cm3) and root surface area density (RAD, root surface area per volume of soil, mm2/cm3) were determined as spatial distribution characteristics.

Step 21.