Crop Growth
-
Root Growth and Development

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Roots: The Hidden Half

Crop growth and Development and Environment

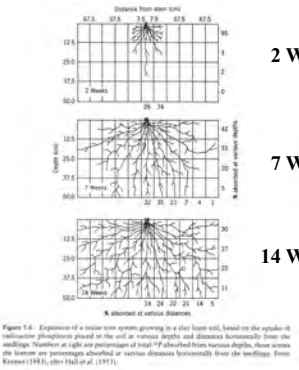
The Roots, the Hidden Half

- ✓ Temporal trends in root growth and development
- ✓ Effects of environmental factors on root growth and development.

Environment - Crop Growth
Root Growth and Development

Temporal Trends in root growth, development and distribution

Maize



2 Weeks

7 Weeks

14 Weeks

Environment - Crop Root Growth
Temporal Trends in Root Growth and Development

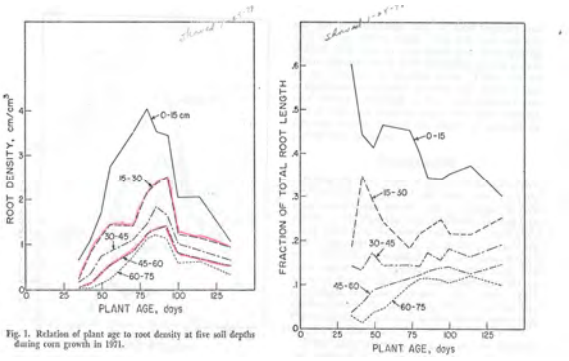


Fig. 1. Relation of plant age to root density at five soil depths during corn growth in 1971.

Environment - Crop Growth
Root Growth and Developmental – Mass Partitioning - Acock

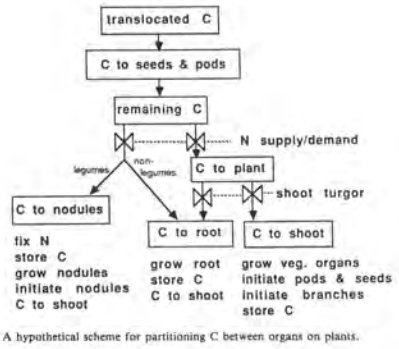


Fig. 4-5. A hypothetical scheme for partitioning C between organs on plants.

Environment - Crop Growth
Root Growth and Development

Effect of Soil Temperature on Root Growth

***Pinus* seedlings**

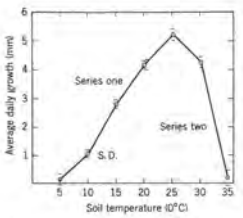


Figure 5.20 Relationship between soil temperature and root elongation of *Pinus taeda* seedlings under controlled conditions. From Kramer (1983), after Barney (1951).

Environment - Crop Growth
Root Growth and Development

Root Weight

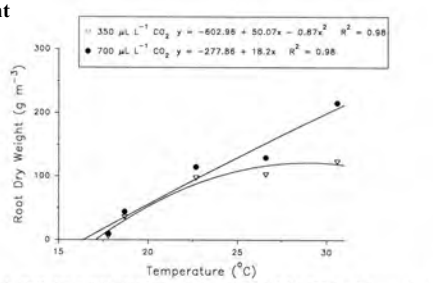


Fig. 1. Root dry weight of cotton plants as influenced by $[CO_2]$ and temperature harvested at 70 DAE.

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Root Growth and Development

Root Numbers

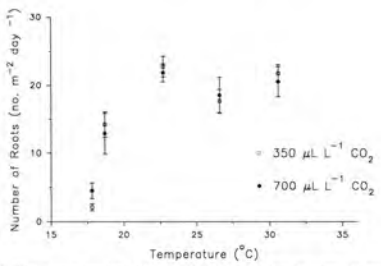

Fig. 2. The average number of roots produced on the glass face over the season as influenced by $[CO_2]$ and temperature treatments.

Environment - Crop Growth
Root Growth and Development

Root Growth Rate

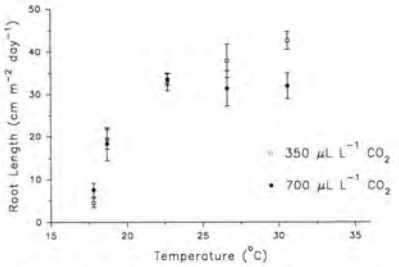

Fig. 3. The average root length visible at the vertical glass face over the season as influenced by $[CO_2]$ and temperature treatments.

Environment - Crop Growth
Root Growth and Development

Root Growth Rate

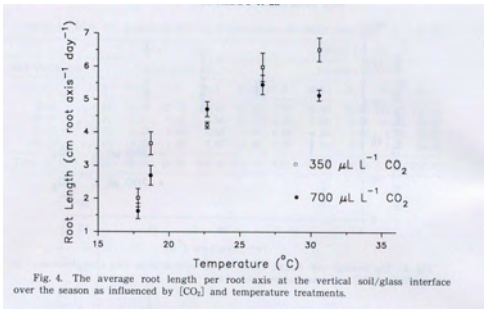

Fig. 4. The average root length per root axis at the vertical soil/glass interface over the season as influenced by $[CO_2]$ and temperature treatments.

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Root Growth and Development

Competition between plants

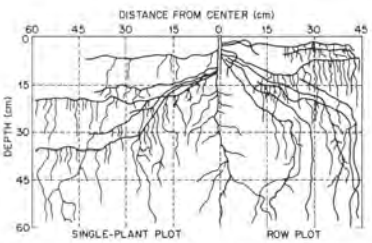


Figure 5.21 Difference in lateral root extension of an isolated soybean root system (left side) and that of a plant growing in a row. From Kramer (1983), after Raper and Barber (1970a).

Environment - Crop Growth
Root Growth and Development

Soil compaction and root growth, development and distribution

11 week-old oat plants

Environment - Crop Growth
Root Growth and Development

Wilted Maize in Flooded Field:

Deficient aeration of soil root not only reduces root growth but also reduces the absorption of water and minerals.

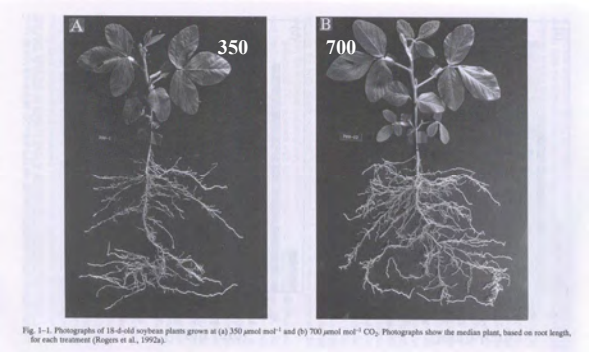
The decrease in water absorption is caused chiefly by an increase in the resistance to radial movement into roots, but a decrease in the osmotic driving force (probably resulted a decreased uptake of salt).

There are wide differences among species of plants with respect to the effects of flooding on water absorption.

Environment - Crop Growth
Root Growth and Developmental Responses to CO_2

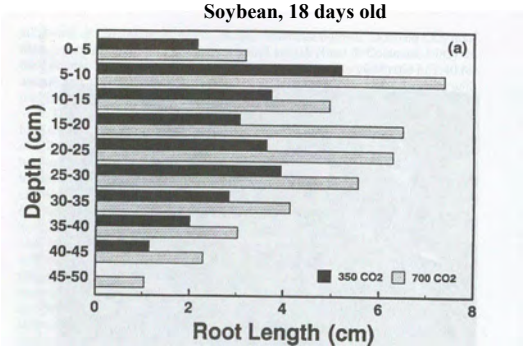
Water and Root and Shoot Growth

Environment - Crop Growth
Root Growth and Developmental Responses to CO_2



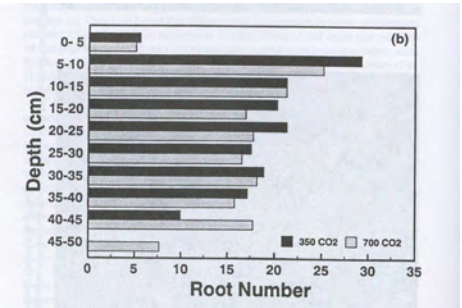
Environment - Crop Growth
Root Growth and Developmental Responses to CO_2

Soybean, 18 days old



Environment - Crop Growth
Root Growth and Developmental Responses to CO_2

Soybean, 18 days old



Environment - Crop Growth
Root Growth and Developmental – Mass Partitioning - Cotton

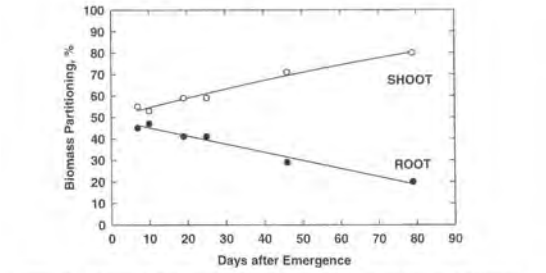


Figure 16 The effect of plant age on biomass partitioning of biomass to roots and aboveground parts (Hodges *et al.*, 1993).

Environment - Crop Growth
Root Growth and Developmental – Mass Partitioning - Cotton

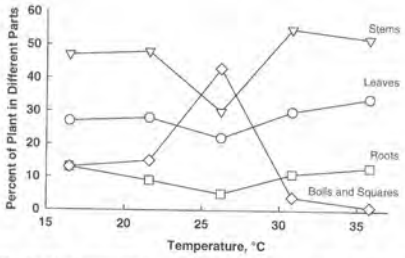


Figure 17 The role of temperature on cotton plant partitioning among different organs (V. R. Reddy *et al.*, 1991).

Environment - Crop Root Growth and Development
Concluding Remarks

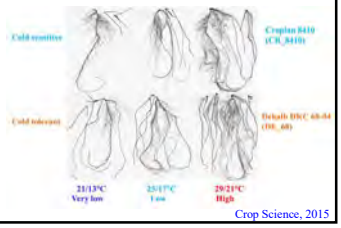
- Progress has been made in recent years in understanding crop root growth and developmental responses to environmental stresses.
- However, quantitative relationships between root growth and developmental responses and environmental stresses are still inadequate.
- New techniques are needed to quantify the responses.
- Models systems may be useful to test hypothesis and validate certain assumptions.

New Systems are Coming, but Challenges are also Present

- **Root images – WinRHIZO dual Scan optical scanner (Regent Instruments Inc., Quebec, Canada)**
- **Images were analyzed using WinRHIZO Pro Software:**
  - ✓ **Cumulative root length**
  - ✓ **Root surface area**
  - ✓ **Average root diameter**
  - ✓ **Root length per volume**
  - ✓ **Root volume**
  - ✓ **Root numbers**
  - ✓ **Roots with laterals**
  - ✓ **Root tips**
  - ✓ **Root forks**
  - ✓ **Root crossings**
  - **Simulation models for root systems**

18-day old corn at 3 Temp.

Win-RHIZO dual Scan optical root scanner



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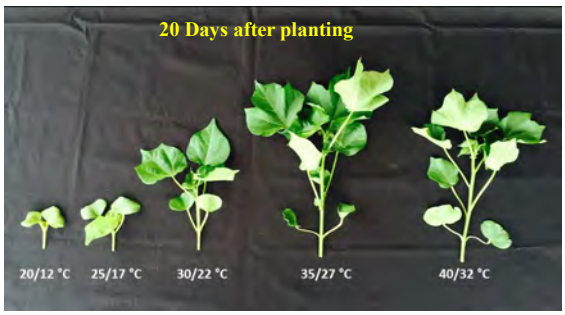
Shoot Growth and Developmental - Cotton



Day/Nigh Temperature Treatments

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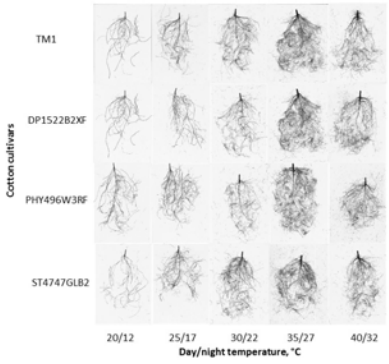
Root Growth and Developmental - Cotton



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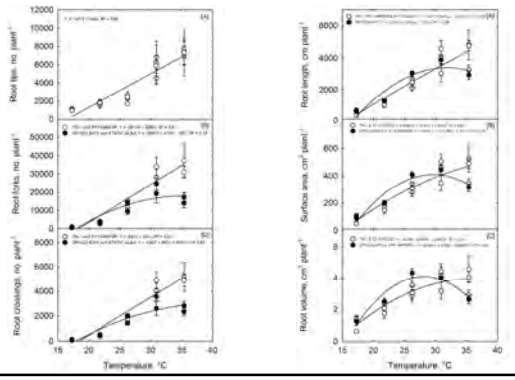
Root Growth and Developmental - Cotton



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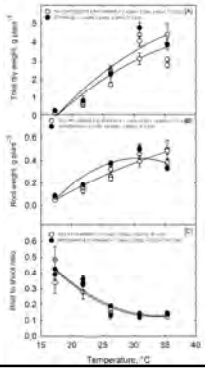
Root Growth and Developmental - Cotton



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