Root to shoot communication in certain temperate and sub-tropical crops grown aeroponically in the tropics

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Aeroponics, the technique of growing plants by bursts of nutrient spray, offers a method to produce temperate or subtropical crops such as lettuce, tomato and capsicum can be grown all year-round in the tropics only by cooling their roots while their aerial parts are grown under hot fluctuating temperature. Our preliminary results indicated that cooling the root-zone of these crops has changed their growth pattern, increasing shoot/root ratio (He and Lee, 1998, J. Plant Physiology, 152, 387-391). The high shoot/root ratio could be due to more photoassimilate being channeled into the harvestable proportion of the crop, thereby increasing efficiency of production. Generally, in addition to water and minerals, roots provide shoots with a number of compounds, which are essential for growth. It is likely that a combination of the direct effects of temperature on root respiration and root-shoot "signals" by plant hormones responsible for the changes of photoassimilate partitioning that remains to be investigated.

**Main Objectives**
The project was mainly concerned with investigating the

i. effects of root-zone temperature (RZT) on source-sink relations (photoassimilate partitioning)

ii. regulation of photoassimilate partitioning

**Plant materials and cultural methods**
Aeroponically grown butterhead lettuce (*Lactuca sativa* cv. *Palma*) and capsicum (*Capsicum annuum* L.) were used as experimental materials. RZT transfer experiments were conducted 3 weeks after transplanting. Half the plants were maintained at their original RZT (either 20°C-RZT or ambient-RZT (A-RZT)), and the other half were transferred to the other RZT. There were thus 4 RZT treatments: 20°C-RZT, A-RZT, 20°C-Chla-RZT and A-20°C-RZT. The RZT transfer experiment was performed three at different times of the year with similar results.

**Methodology**
The effects of RZT on source-sink relations was by feeding radioactive 14C. Cytokinins such as iPA, ZR and DHZR was determined by ELISA method with microtitration plates (Automatic Microplate Reader, Bio-Tek instruments, Inc. USA).

**Main results**
Our studies indicated that another advantage of the aeroponic system was an increased harvest index due to higher shoot/root ratio induced by cooling the roots of lettuce and capsicum plants grown under hot fluctuating ambient temperature. The high shoot/root ratio was due to more photoassimilate being channeled into the harvestable proportion of the crop, thereby increasing efficiency of production. Our results also suggested that "chemical signals" such as cytokinins produced by cooling the roots of temperate crops grown in the tropics moving from roots to shoots may affect photoassimilate partitioning. With the understanding of photoassimilate partitioning and the regulation of partitioning in plants grown under given conditions, certain exogenous growth regulator could probably be applied to the plants to enhance photoassimilate distribution to harvestable organs.

Our achievements on using aeroponic technologies to investigate the shoot-root communication of plants (academic research) and to produce high-value vegetables (commercial application) have gained international recognition. A/P He Jie was invited as a key speaker to give a talk on "Control of the root environment with aeroponic technology" for the NCL Workshop entitled "Control of the Root Environment with Soil-less Technologies" on 26 April 2001 in Auckland, New Zealand. The workshop was organized by The Horticulture and Food Research Institute of New Zealand Ltd. The presentation of the keynote address was well received.

Some of the results have been published in the following journals and book:


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