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GROWTH OF SWEETPOTATO TUBER AS AFFECTED BY THE AMBIENT HUMIDITY

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EGUCHI T., KITANO M. and EGUCHI H. *Growth of sweetpotato tuber as affected by the ambient humidity.* BIOTRONICS **27**, 93–96, 1998. A tuber of sweetpotato plants (*Ipomoea batatas* Lam. cv. Koganesengan) was grown in the air space of a hydroponic system, where relative humidity around the tuber was controlled at 50, 70 or 90%RH under an air temperature of 28℃. Diurnal variation of the tuber volume was measured on-line by using a laser micrometer system, and effect of the ambient humidity on the tuber growth was analyzed. In all of the humidity conditions, the larger increase in the tuber volume was found during the nighttime. The nighttime growth rate was clearly affected by the humidity around the tuber, which became higher in the order of 90, 50 and 70%RH.

Key words: *Ipomoea batatas* Lam.; tuber growth; ambient humidity.

INTRODUCTION

A hydroponic system was developed for environmental studies on the sink-source relationships in sweetpotato plants (*Ipomoea batatas* Lam.), where the tuber is grown in the air space under the controlled environment (*1*). In the hydroponic system, dynamics of volume change in the tuber can be measured on-line by applying a laser micrometer system (*2*). Tuber growth analysis using the above systems revealed that diurnal fluctuation exists in the growth pattern of the tuber, where the growth rate during the daytime is depressed remarkably as compared with the nighttime rate (*3*). As reported in the previous paper (*4*), the tuber growth is affected by the shoot environments, such as light intensity and humidity, through changes in leaf transpiration. Leaf transpiration is considered to affect sap flux into the tuber, and dynamics of tuber growth depends on the balance between the sap flux and evaporative water loss from the tuber surface. This implies that the tuber growth might be also affected by the ambient humidity through the evaporative water loss. The present paper deals with analysis of diurnal growth in sweetpotato tuber under different humidity conditions around the tuber.

MATERIALS AND METHODS

Plant materials

Cut-stems of sweetpotato (cv. Koganesengan) were sand-cultured for one month in a phytotron glass room controlled at an air temperature of 25℃ and a relative humidity of 70%. After the cultivation, the plant with a single tuber (about 5 cm^3 volume) was prepared for the tuber growth measurement under the controlled environment as described previously (*3*).

Tuber growth measurement and environmental conditions

Material plant was transplanted into the sweetpotato hydroponic system for the tuber growth analysis (*3*). Relative humidity around the tuber was controlled at 50, 70 or 90±4% under an air temperature of 28±0.5℃. Shoot environment was controlled at an air temperature of 28±0.5℃, a relative humidity of 70±3%, a light intensity of 300 μmol m^{-2} s^{-1} and a photoperiod of 12 h (07:00~19:00). Nutrient solution temperature was controlled at 28±0.5℃.

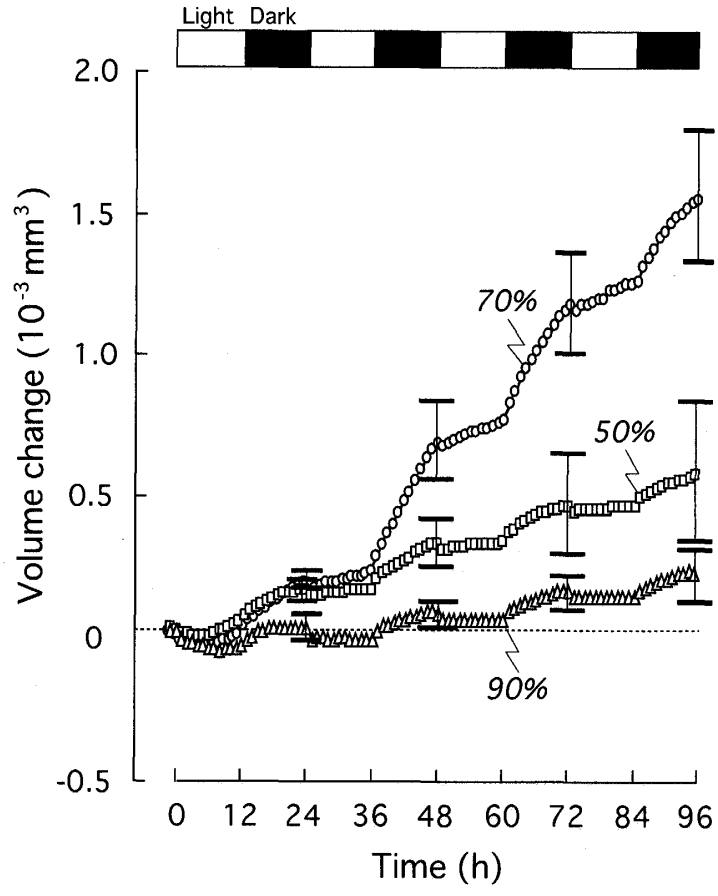

Fig. 1. Time course patterns of volume changes in sweetpotato tubers grown under the respctive humidity conditions of 50, 70 and 90%RH for 96 hours. Means of three plants were plotted. Vertical bars show 95% confidence limits at 24, 48 and 72 hours.

Tuber growth measurement was started from the on-set of the light period after 12 h acclimation of the plant to the hydroponic system under the dark condition. Tuber volume was measured at one hour intervals for four days (96 hours) by using the on-line laser micrometer system (*2*). In each condition of the relative humidity around the tuber, volume change and relative growth rate of the tuber were evaluated in time course, and those data were represented as the means of three plants.

RESULT AND DISCUSSION

Figure 1 shows time course patterns of volume changes in sweetpotato tuber under the respective humidity conditions of 50, 70 and 90%RH. Tuber growth obviously differed among those humidity conditions, where the volume increment during four days was about 0.6, 1.5 and 0.2 cm^3 at 50, 70 and 90%RH,

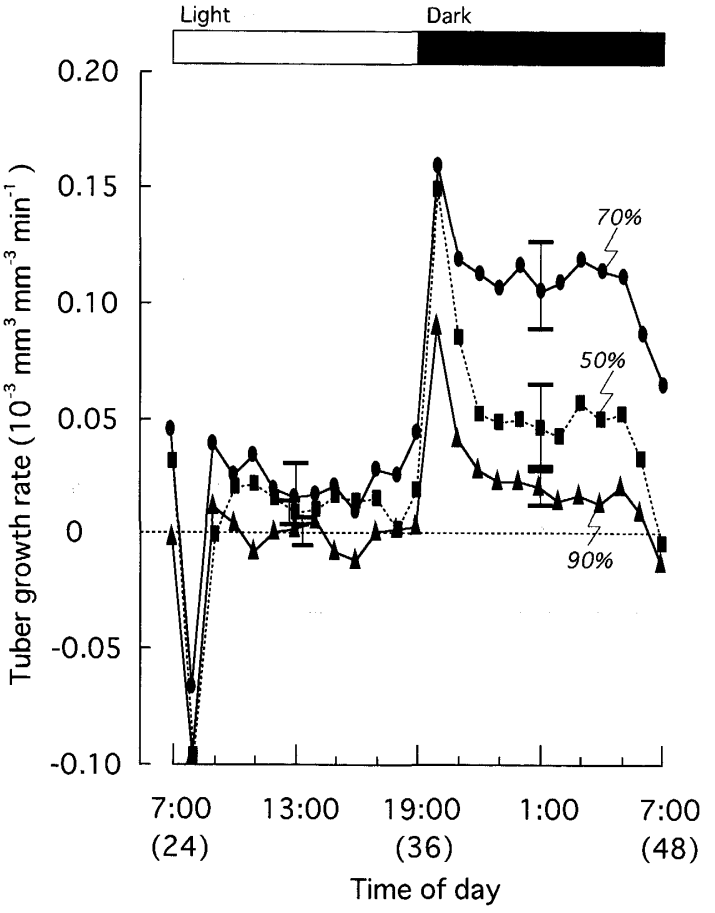

Fig. 2. Typical patterns of diurnal changes in relative growth rate of sweetpotato tubers grown under the respective humidity conditions of 50, 70 and 90%RH. Means of three plants on the second day (from 24 h to 48 h in Fig. 1) were plotted, and data at midday (13:00) and midnight (01:00) were shown with 95% confidence limits.

respectively. On the first day (24 h), the tuber growth at 90%RH was depressed significantly as compared with those at 50 and 70%RH. On the second day (48 h), the growth difference between 50 and 70%RH reached a significant level. In all the humidities, the larger increase in the tuber volume was found during the dark periods. Figure 2 shows typical patterns of diurnal changes in tuber growth rate under the respective humidity conditions. Significant difference among the three humidities was not observed during the light period. On the other hand, the growth rate during the dark period was quite different among those humidities, where the midnight (01:00) rate was about 0.05×10^3, 0.11×10^3 and 0.02×10^3 mm^3 mm^{-3} min^{-1} at 50, 70 and 90%RH, respectively. The most active growth of the tuber was found at 70%RH, whereas the tuber growth at 50 and 90%RH was significantly depressed as compared with that at 70%RH.

Thus, growth of sweetpotato tuber was affected by the ambient humidity, and the nighttime growth of the tuber seemed to be more sensitive to humidity than the daytime growth which is considered to be depressed seriously for active leaf transpiration (*4*). The depressed tuber growth found at 50%RH is considered to be attributed to the larger evaporative water loss from the tuber surface. On the other hand, the evaporative water loss cannot explain the growth depression at high humidity condition of 90%RH. Further researches are required for understanding relationships between water balance and volume change in sweetpotato tuber.

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