EFFECT OF AIR HUMIDITY AROUND TUBEROUS ROOT ON SINK STRENGTH IN SWEET POTATO PLANTS GROWN IN A SOLUTION-AIR CULTURE SYSTEM

Eguchi, Toshihiko
Biotron Institute Kyushu University

Kitano, Masaharu
Biotron Institute Kyushu University

Eguchi, Hiromi
Biotron Institute Kyushu University

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EFFECT OF AIR HUMIDITY AROUND TUBEROUS ROOT ON SINK STRENGTH IN SWEET POTATO PLANTS GROWN IN A SOLUTION-AIR CULTURE SYSTEM

T. EGUCHI, M. KITANO and H. EGUCHI

Biotron Instirute, Kyushu University 12, Fukuoka 812–81, Japan

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EGUCHI T., KITANO M. and EGUCHI H. *Effect of air humidity around tuberous root on sink strength in sweet potato prants grown in a solution-air culture system.* BIOTRONICS **24**, 45–49, 1995. Sweet potato plants (*Ipomoea batatas* Lam.) were grown in a solution-air culture system, where the tuberous root was kept in an air space above a nutrient solution. Effect of air humidity in the air space on sink strength of tuberous root was examined under the respective humidity conditions of 50, 70 and 90±8%RH at a root temperature of 24±0.5℃. Fresh weight of tuberous root became higher at higher humidities. Dry weight was lowest at 50%RH and almost the same at 70% and 90%RH. At 90%RH, however, the larger part of dry matter was partitioned to adventitious buds than to tuberous root. Sink strength of tuberous root, which was estimated by dry weight per unit leaf area, was found to be maximized at 70%RH.

Key words: *Ipomoea batatas* Lam.; tuberous root; air humidity; sink strength; solution-air culture system.

INTRODUCTION

Sweet potato plants (*Ipomoea batatas* Lam.) form tuberous roots as a major sink. In the previous paper, effect of root temperature on sink strength of the tuberous root was examined in a sand culture system, and it was suggested that sink strength of the tuberous root was maximized at a root temperature of 24℃ (*1*). For exact analysis of plant responses to root environments, hydroponics is considered to be a suitable culture system because root environments can be controlled. In general, formation of tuberous root, however, is difficult in the hydroponic system where the whole root is immersed in the nutrient solution. Uewada (*3*) showed that tuberous root can be formed in the air space of a solution culture box. Sugi *et al.* (*2*) have proposed to call "solution-air culture system" which consists of solution and air spaces in hydroponics. In the solution-air culture system, upper part of root system is kept in an air space, and sink strength of tuberous root is supposed to be affected not only by root temperature but also by air humidity around the tuberous root. The present paper deals with analysis of humidity effect on sink strength of tuberous root in sweet potato plants grown in a solution–air culture system.

MATERIALS AND METHODS

Plant materials

Cut–stems of sweet potato plants (cv. Koganesengan) were prepared as described previously (*1*). After 25 days cultivation in a phytotron glass room (an air temperature of 25℃ and a relative humidity of 70%), all roots except for the tuberized root of the largest diameter (4 to 6mm) were excised, and the plants with the single tuberized root were used for plant materials.

Environment control

Figure 1 shows the schematic diagram of a solution–air culture system. A culture box (35.8 ℓ) made of polyvinyl chloride was placed in a water bath system. The air space of root environment was 23 ℓ in volume and 12 cm in depth, and the nutrient solution layer was 12.8 ℓ in volume and 8 cm in depth. Air temperature and relative humidity in the air space of root environment were controlled by air conditioning unit, and temperature of nutrient solution was controlled by the water bath system. Eight of the material plants were transplanted to the solution–air culture system, and a root temperature was controlled at 24±0.5℃ at which sink strength of the tuberous root was found to be maximized (*1*), and relative humidity around tuberous root was controlled at 50, 70 and 90±8%. The solution–air culture system was installed in a growth chamber, where the environment was

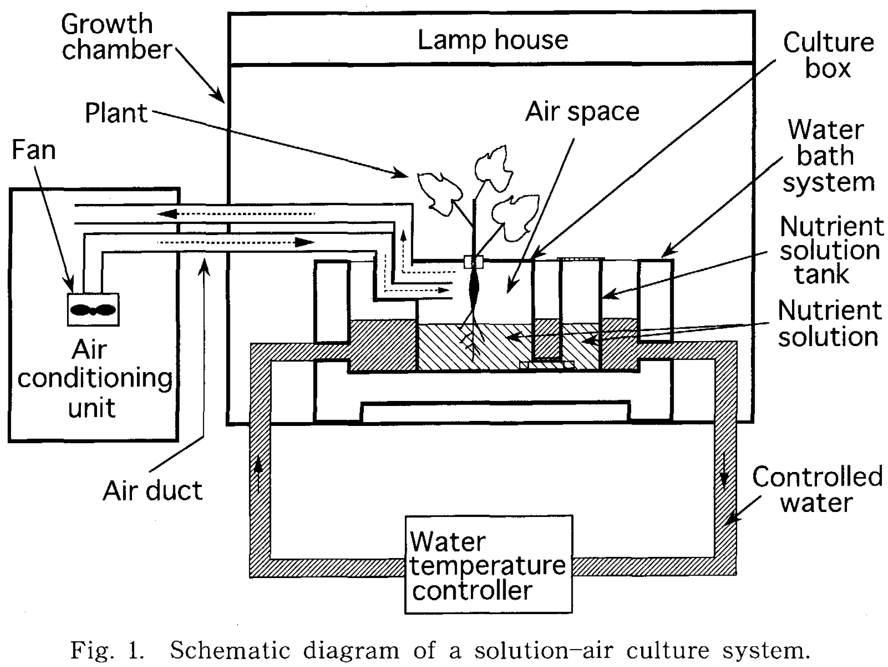

Fig. 1. Schematic diagram of a solution–air culture system.

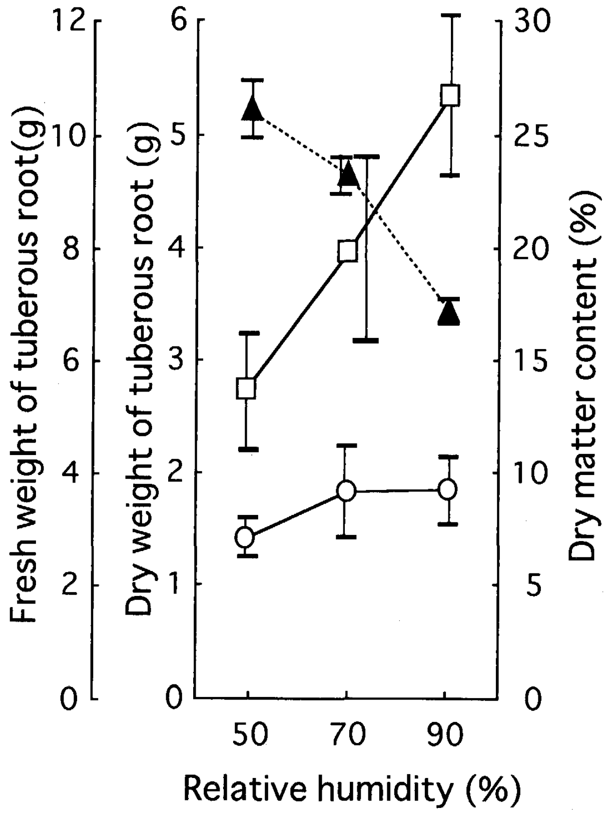

Fig. 2. Fresh weight (-□-), dry weight (-○-) and dry matter content (··▲··)of tuberous root at different humidities in air space of solution-air culture system. Means of 5 plants at 40 days after transplanting are plotted with 95% confidence intervals.

controlled at an air temperature of 28±0.5℃, a relative humidity of 70±3% and a light intensity of 300 μmol m^{-2} s^{-1} (fluorescent lamps and incandescent lamps) in a photoperiod of 12 h.

Plant sampling and data analysis

At 40 days after transplanting, five plants of healthy growth were sampled under each humidity condition. Fresh and dry weights of leaf, stem, petiole, adventitious bud, tuberous root and fibrous root were measured. Dry matter content was evaluated as dry weight percentage to fresh weight. Sink strength of each organ was estimated by dry weight per unit leaf area as the previous paper (*1*).

RESULTS AND DISCUSSION

Figure 2 shows fresh weight, dry weight and dry matter content of tuberous root at different air humidities in air space of solution-air culture system. Fresh weight of tuberous root became higher at higher humidities. Dry weight was lowest at 50%RH and was almost the same at 70% and 90%RH.

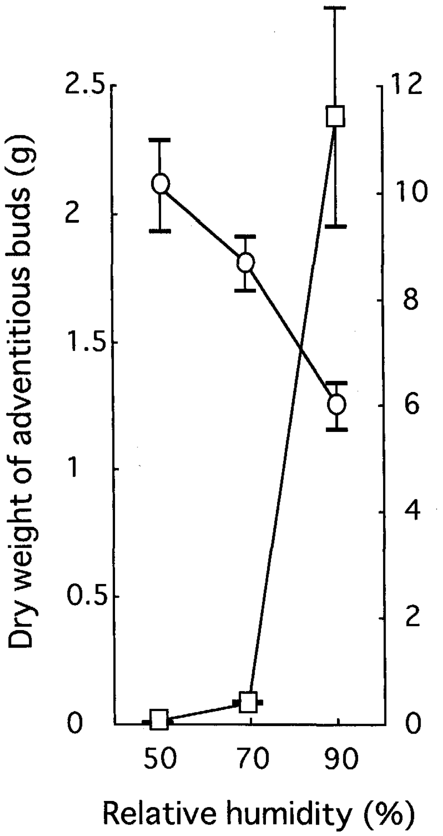

Fig. 3. Dry weight (-□-) and dry matter content (-○-) of adventitious buds emerged from tuberous root at different humidities in air space of solution-air culture system. Means of 5 plants at 40 days after transplanting are plotted with 95% confidence intervals.

On the other hand, dry matter content became lower at higher humidities.

Figure 3 shows dry weight and dry matter content of adventitious buds emerged from tuberous root at different air humidities. Dry weight of adventitious buds became higher at higher humidities. Dry matter content of adventitious buds became lower at higher humidities as found in tuberous root.

Figure 4 shows dry weight of each organ per unit leaf area at different air humidities. The total dry weight per unit leaf area was lowest at 50%RH and was almost the same at 70% and 90%RH. Dry weight of tuberous root per unit leaf area (i. e. sink strength of tuberous root) was highest at 70%RH. Dry weight of adventitious buds per unit leaf area (i. e. sink strength of adventitious buds) was highest at 90%RH, and portion to total dry weight was higher than that of tuberous root (adventitious buds 19.4% vs. tuberous root 15.4%). Thus, larger part of dry matter at 90%RH was partitioned to adventitious buds than to tuberous root. On the other hand, at 50% and 70%RH sink strength of adventitious buds was highly depressed, and larger part of dry matter was partitioned to tuberous root than to adventitious buds. From

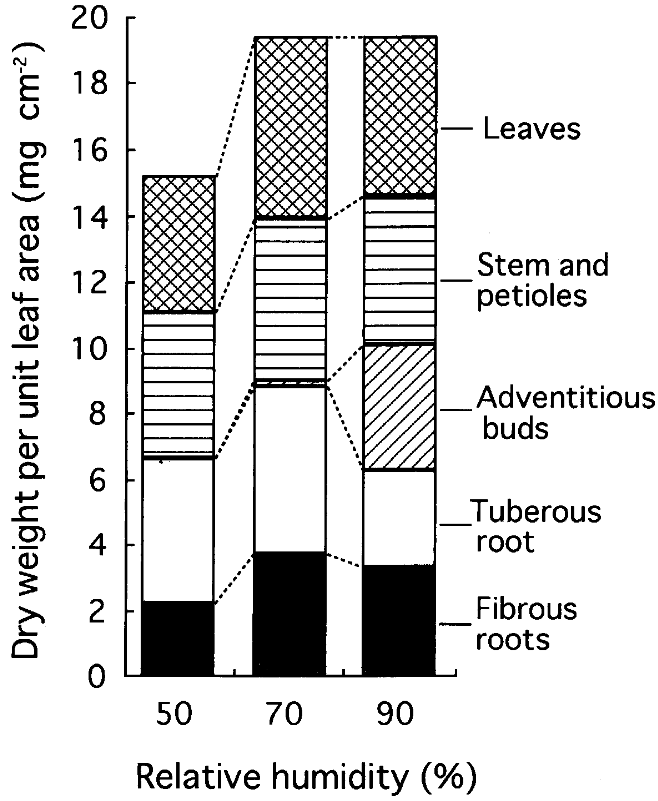

Fig. 4. Dry weights of each organ per unit leaf area at different humidities in air space of solution-air culture system. Means of 5 plants at 40 days after transplanting are plotted.

the results, air humidity around tuberous root could affect dry matter partitioing through change in sink strength of adventitious buds emerged from tuberous root, and sink strength of tuberous root was found to be maximized at 70%RH.

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