Process 3. It is scheduled to transfer the seedling production phase in a greenhouse that needs advanced technology to a machine to some extent; to build the open-style seedling production system, to mitigate labor.

In the future, we will be able to demonstrate this new vegetable seedling production system, "New Generation Soil-less Seedling (provisional name) (Fig. 3, Fig. 4). This is the new grafting and cutting method, which makes it possible to store seedlings for a few weeks in environmentally controlled rooms. This method will also make it possible to package the production in a small size that will decrease packaging costs. We will be looking to apply this system in other new market and hope to change the current seedling production system in Japan.

We will continue to seek new technologies.

The Changing Greenhouse Environment During the Seasons for Grafted Vegetable Nursery Plants©

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INTRODUCTION

At Yamaguchi-Engei grafted vegetable nursery plants [e.g., cucumber (*Cucumis sativus*), tomato (*Lycopersicon*), eggplant (*Solanum melongena*), etc.] are produced and sold all year. Berg Earth Co. Ltd. supports Yamaguchi-Engei Co. Ltd. with research and development. It is very difficult to maintain nursery-plant quality through the year because environmental factors, such as air temperature, humidity, and light, change with the season and weather. To solve these problems we use heaters, shield-curtains, and plastic tunnels to control the environment in greenhouses. The object of this study was to investigate the environmental changes during the seasons and to improve culture techniques for each season.

MATERIALS AND METHODS

This research was carried out from early October 2001 to early September 2002 at the research facilities of Yamaguchi-Engei Co. Ltd. The environmental measurement system "Open PLANET" (Shikoku Electric Power Co., Inc.) was used to monitor air temperature, relative humidity, and luminance. Sensors were set both outside and inside the tunnel frames (Fig. 1). Data was logged as averages every 10 min.

RESULTS AND DISCUSSION

Figure 2 shows the change in environmental factors (air temperature, relative humidity, and luminance) in each area (open air, outside tunnel, inside tunnel). In the case of relative humidity and luminance, there was little difference between the outside and inside of the tunnel, 10% to 34% of amplitude, compared with the open air. However, the change in air temperature was large; there was a 57% and 62% of amplitude between outside and inside of the tunnel, compared with the open

air. Outside and inside the tunnel in the winter it was necessary to increase the air temperature by more than 15°C with heating, but in the summer it was not possible to control the high temperatures. It is important to control the high summer temperatures to maintain the constant quality of nursery plants all year. The difference between the highest and the lowest air temperature outside and inside the tunnel was the largest (20°C) between November and March (Fig. 3).

It is necessary to be careful in the season that had large difference in the air temperature.

Figure 1. The sensors of OpenPLANET.
1. The sensors outside the tunnel flames.
2. The sensors inside the tunnel flames.

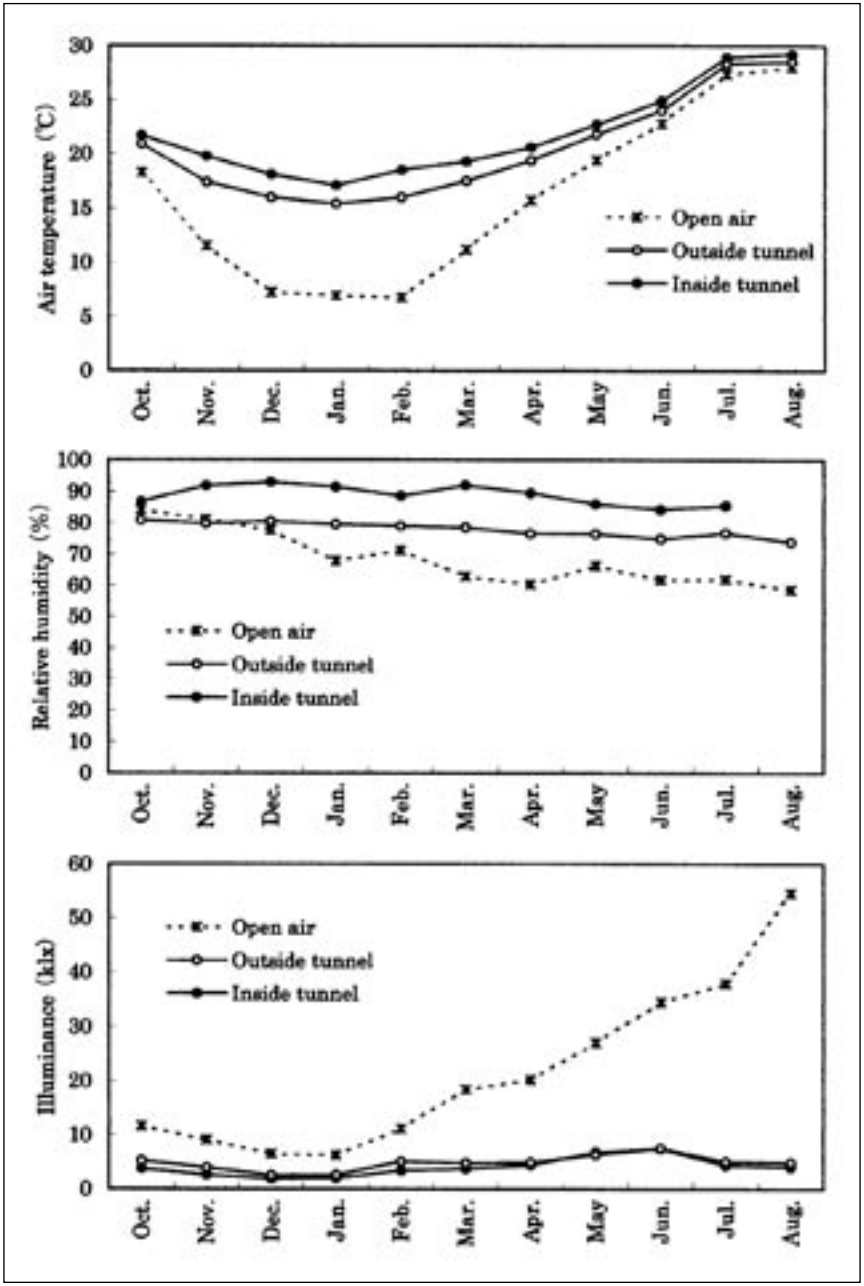

Figure 2. The change of air temperature, relative humidity and illuminance. The data is the monthly average.

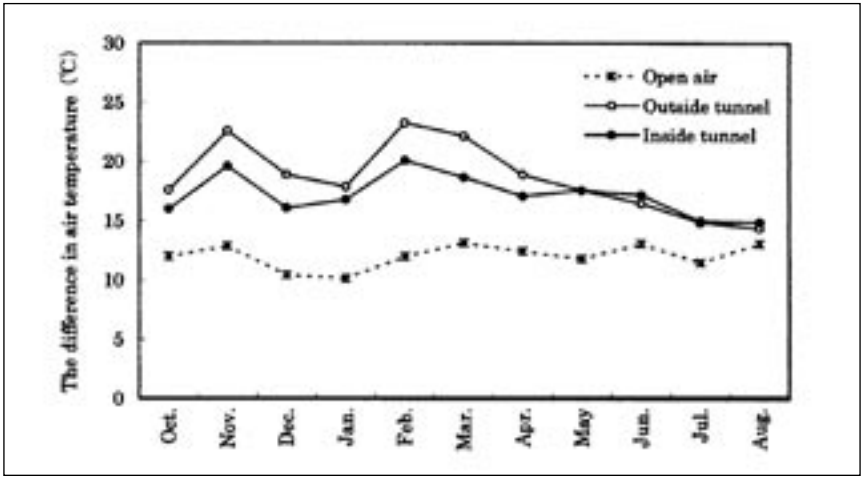

Figure 3. The average of the daily temperature difference between the highest and the lowest.