Controlling Root Systems with Slit Containers

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In the container production of many horticultural plants, root circling is a serious problem. It is especially important in the production of large trees to prevent root circling as it has a deleterious effect on the growth after planting out. In many nurseries, however, trees are often grown without any treatment to prevent root circling. As a result, root distortion and aging can be observed at an early stage of growth. In addition, street trees with weak root systems are uprooted easily by strong winds such as typhoons. Therefore, we investigated the combination of soil media in the container, the amount of watering, and the material and structure of the container in order to avoid root circling.

The soil medium used in the experiment was mainly composed of a mixture of red earth or weathered granite as the basal medium and peat moss. The mixture was adjusted by adding kanumatsuchi, hyugatsuchi, perlite, and charcoal to improve the physical condition of the medium. Attention was paid to supplying the plants with adequate water to enable good growth, that is, a large amount of water was supplied to the plants whilst in active growth and reduced when growth ceased. The plants were spaced far apart to prevent disease by allowing good air movement, which also allowed for good soil aeration.

It was considered that the structure and material of the container affected the moisture content of the medium which in turn affected plant growth. A large proportion of the water supplied to the medium drained from the container. Some water remained at the bottom of the container through surface tension. Moreover, condensation formed on the inside surface of the container because of the difference in day and night temperatures. Therefore, the soil medium in the bottom of the container became wet and lacked oxygen. Then, the root cells became deformed, and the lateral roots grew spirally downward along the inside surface of the container without branching. This is the first sign of circling, eventually resulting in deformed roots. Accordingly, we devised a container with an overflow slit which is easily able to drain the water remaining at the bottom. Using the slit container, the circling of roots is prevented, and similar results were observed in slit containers made of other materials, such as paper, cloth, and china. A plug tray of this type was also developed.

When plants are grown in the slit container, root tips cease growing once they come into contact with the container wall, and new roots are formed from the base of the plant, not from the growing tip of the root. By this method, production of well-shaped large trees became possible with a limited amount of soil media in a short time. The improved root system, without circling, produced a better plant. The same benefits of the slit container were also observed with some fruiting vegetables such as sweet pepper and egg plant, and made a marked difference in annual seedlings.

The phenomenon might be explained by the physiological relationship between roots and leaves as described below. With a sufficient supply of oxygen, the root tips cease growth, and synthesis of cytokinins commences. The hormones are translocated to the leaves, contributing to an active synthesis of protein, development of buds, and expansion of leaves. Consequently, photosynthetic products and auxins synthesized in the leaves are translocated to the roots and promote differentiation and development of lateral roots from the base of the plant.