CONCLUSIONS

Myoga flower bud production is a very new industry to New Zealand, established to provide product during the Japanese off-season. It is seen as a small niche market that could easily be destroyed through oversupply. The Myoga Product Group regulates the production and supply of myoga to the market. At present, it is not known how large the market is for off-season production.

Myoga production in Japan is an old industry carried out on small family plots. In New Zealand the industry tends to be on a larger scale, with many of the traditional production techniques being unsuitable in the New Zealand context. Research by both growers and Crop & Food Research is ongoing.

It is an exciting beginning, with trial plantings establishing and growing well, but the long-term viability of the industry will depend on the market, and the ability of New Zealand growers to adapt Japanese small-scale farming techniques to their own circumstances.

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Closed, Plant-Production System—Update

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Since initiation of the research in 1990, diverse plants from 42 families (68 genera, 72 species) have been grown in the closed, insulated pallet system (CIPS). Greater growth has occurred in various embodiments of the plant-driven CIPS than in the open container system (OCS) control. Branching of roots, and of shoots of some plants, is greater in CIPS. *Phytophthora cinnamomi,* a plant root pathogen, does not spread from inoculated to noninoculated root pouches in CIPS. In the greenhouse, tomato plants are more tolerant of saline irrigation water, and production is more profitable in CIPS than in the OCS.

INTRODUCTION

The closed, insulated pallet system (CIPS) is a low-maintenance, resource-conservative production system. Description of the CIPS, methods of plant production in the CIPS, and past research are described in several publications (Blackburn, 1992; Briggs and Green, 1991; Green and Briggs, 1992; Green et al., 1993; Hayter, 1992; Hughes, 1992; Kaplan, 1992; Roberts, 1991; Wijchman, 1991). The following is an update of research not previously reported.

RESEARCH UPDATE

Intermixed Plants in Plant-Driven System. Growth of diverse plants from 42 families (68 genera, 72 species) has been better in CIPS than in OCS. In several experiments, plants with diverse water and fertilizer requirements and growth rates were planted in the same root pouch or in individual root pouches within the same pallet. Growth of plants sharing common water and fertilizer reserves in CIPS was comparable or greater than that of plants in individual OCS. In the "trough" experiment, planted in Sept. 1992 at Briggs Nursery, increases in height and stem diameter of cutleaf European birch, *Betula pendula* 'Laciniata', with 3-liter root-media volume were greater in CIPS than in OCS—90 cm height and 1.3-cm stem diameter in OCS and 124 cm height and 2.2-cm stem diameter in CIPS on 28 June 1994.

In CIPS, after water adsorption on root medium particles and filling of capillary pores has reached equilibria, further flow of water from the underlying reservoir and from the medium, is in response to plant root uptake to support growth and transpiration. Water-flow upward from the reservoir is plant driven to meet that plant's specific requirements. Water in the plant-root medium is moved upward into the medium from the water reservoir. It is held in the medium by adsorptive and capillary forces that are greater than the force of gravity. There is no downward gravitational movement of water through the fertilizer or root medium to the water reservoir in the pallet base.

Fertilizer moves downward from the fertilizer reserve on the top surface of the media by chemical diffusion. Plants within the same pouch share a common fertilizer reservoir at the top surface of the media. Rate of movement of fertilizer to the roots of the individual plants is related to the rate of fertilizer uptake by each root. Fertilizer diffusion rate increases as plant uptake causes an increased gradient between the fertilizer reservoir and the plant root surface.

Because of the plant-driven movement of water from the basin reservoir and plant-driven increase in movement of fertilizer from the fertilizer reservoir at the top surface of the medium, large quantities of fertilizer and water may be added to the reservoirs at the grower's convenience. For example, a quantity of water adequate for a year or more can be placed and stored in the pallet reservoir when water is readily available. Also, a quantity of coated fertilizer could be placed and stored in the fertilizer reservoir once or twice a year.

The plant-driven increase in movement of fertilizer and water in the CIPS enables intermixing plants with different growth rates (different water and fertilizer requirements) within the same planting pouch or pallet. The uptake rate of each individual plant will affect the rate of diffusion of water and fertilizer from the reservoirs to that plant's roots.

Plant Growth and Development. Growth and branching of roots, and in some cases of shoots, of plants grown in CIPS in pouches having an inner surface coating of copper hydroxide, is greater than that of plants grown in OCS. For example, 220 days after *Photinia ×fraseri* 5.7-cm liners, were planted into CIPS and OCS, plant shoot gdm (75.3 gdm/CIPS, 46.8 gdm/OCS), shoot height (153 cm/CIPS, 98 cm/OCS) and shoot branching (4 branches/CIPS, 0 branches/OCS) were significantly greater in CIPS than in OCS. Similarly, 90 days after *Daphne ×burkwoodii* 'Carol Mackie' liners were planted into CIPS and OCS, shoot dry weight was significantly greater for plants grown in CIPS (3.3 gdm/CIPS, 1.39 gdm/OCS). Greater shoot branching in CIPS may be due to warmer root temperatures and a more positive difference between the root and shoot temperatures (DIFRS) in CIPS than in OCS. Several researchers have reported increased numbers of axillary shoots of unpinched plants when root temperatures are warmer than shoot temperatures (McAvoy, 1992; Merritt and Kohl, 1982; Wulster and Janes, 1984). Further research on effect of DIFRS on growth and development of various plants is planned. Equal or greater plant response may be attained with warm root temperatures within the closed, insulated pallet and lower greenhouse air/shoot temperatures. If so, then significant reductions in energy expenditures for greenhouse heating will be realized.

***Phytophthora cinnamomi* does not Spread Within CIPS.** The potential for spread of *Phytophthora cinnamomi* (root rot) from pouch-confined, inoculated root systems to noninoculated roots of plants sharing a common water reservoir in pallet base was evaluated.

Phytophthora cinnamomi inoculated and noninoculated plants were grown in root pouches with or without an inner surface coating of copper hydroxide. At the end of the experiment, *P. cinnamomi* was recovered from inoculated but not from noninoculated plant roots nor from the common water reservoir. The copper hydroxide interface was not the factor preventing spread of *P. cinnamomi* from inoculated to noninoculated root pouches. The lack of movement of *P. cinnamomi* from one plant to another in CIPS is attributed to the lack of movement of water from one pouch to another. In CIPS, water movement is always upward from the water basin into the root medium and there is no splashing.

Tolerance of Saline Water in CIPS. In order of importance, the greatest differential incidence of blossom-end rot (BER) was related to genotype (45% BER/variety 1; no BER/variety 2) followed by salinity (50%/saline irrigation; 31%/nonsaline), nitrogen form (45% BER/ammonium fertilization; 33%/nitrate), and production system (45%/OCS; 38%/CIPS). Plant growth (plant shoot gfw) was most affected by the production system (359 gfw/CIPS; 187 gfw/OCS) followed by water salinity (386 gfw/nonsaline; 266 g fresh wt/saline). In looking only at growth of the 'Santiam' tomato cultivar, greatest growth and yield and least BER occurred in CIPS with nonsaline water.

Plant growth and yield and BER incidence in CIPS with 4500 ppm salinity irrigation water were not significantly different from that of OCS plants irrigated with nonsaline water. When 4500 ppm salinity irrigation water was used in both CIPS and OCS, significantly greater yield and less BER occurred in CIPS compared with OCS. CIPS is more amenable than OCS to use of saline irrigation water. Additional research using salt-tolerant tomato rootstocks and using halophytic companion plants in the same pouch with the tomato plant is planned. The halophytes that will be evaluated remove salt from the container media and store it in shoot and leaf tissues.

Cost analyses and sensitivity analyses of the contemporary Dutch greenhouse nondeterminant tomato production system, and the proposed greenhouse determinant tomato production in CIPS, with one-time harvest/crop cycle were done by Strik et al. (1993). In CIPS, three crop cycles (110 to 120 days/cycle) or harvests occur annually per given pallet with continuous planting and harvesting of pallets occurring throughout the year. The CIPS was less sensitive to changes in fruit market price, labor costs, and interest rates and was over seven times more profitable.

CONCLUSIONS

Research has established the economical and technical feasibility of CIPS as an alternate system for outdoor production of container-grown nursery plants and for greenhouse tomato production.

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