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PRELIMINARY OBSERVATIONS AND LITERATURE REVIEW CONCERNING PROBLEMS WITH SHIPPING OF MINIATURE ROSES

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Miniature rose plants have recently been increasing in popularity in the United States. Traditionally, dormant plants have been shipped to producers who force the plants for local sales or by mail order direct to consumers. With the need for "new" potted plants in the retail market in this country, there is growing interest in producing miniature roses in bud and flower for increased sales. Experienced growers have noted that plants in prime condition hold up well when shipped at cool temperatures. However, due to the small numbers desired at any one location and time, shipping by refrigerated truck is not cost effective at this time. When plants are in transit for more than three days, problems of leaf abscission are encountered leaving the plants viable but unsightly for retail sales.

Abscission is an active physiological process by which higher plants shed organs as a result of cell separation (Leopold, 1971). The abscission of leaves has been demonstrated to be under strong hormonal control. Generally, auxin (IAA) has been shown to delay abscission while ethylene has been shown to promote the process (Leopold, 1971, Sexton and Roberts, 1982). Low levels of cytokinins have been correlated to greater leaf and fruit abscission in several plant systems (Addicott, 1982). Carbon dioxide and silver ions can inhibit ethylene-mediated processes including abscission (Sexton and Roberts, 1982). Abscisic acid (ABA) can also accelerate abscission, however, there is some controversy as to whether it acts directly or in an indirect role by stimulating internal ethylene production (Sexton and Roberts, 1982).

Carbohydrate status of a plant has been known for some time to be important in preventing abscission of leaves, flowers, and fruit. Generally, conditions promoting the accumulation of carbohydrates can be increased with critically high levels of light intensity to prolong leaf retention (Roy and Chatterjee, 1967). Abscission can also be prevented in many woody plants by long photoperiods whereas short photoperiods, such as during autumn, trigger seasonal leaf fall or abscission. This phenomenon can be related to seasonal changes in carbohydrate storage and distribution in various plant parts as well as hormonal changes and relationships (Addicott, 1982, Brandon, 1939, Tromp, 1983).

As a rose shoot ages, leaves become exporters of photosynthate (sources) after primarily importing photosynthate (sinks) during early development, though they remain sinks for nutrients (Addicott, 1982, Mor and Halevy, 1984). As maturity advances, leaves become sources such that nutrients and carbohydrates are mobilized out and the leaf abscises (Addicott, 1982). Maintenance of sink strength would, therefore, prolong retention of the leaf. Cytokinins have been shown to maintain sink strength in roses as well as other plants (Addicott, 1982, Mor and Halevy, 1984, Mor et al., 1981).

In an applied study, Pink and Orange Koster and Red Garnette rose plants were sprayed prior to simulated shipping with 15 and 30 ppm NAA (naphthaleneacetic acid) which accelerated leaf abscission, but prevented bud drop, though the buds would not open (Halevy and Kofranek, 1976). In the same study, a spray of 50 ppm PBA 96-(benzyl-amino-9-(2-tetrahydropyranyl)-9H-purine) prior to simulated shipping reduced leaf yellowing and abscission, prevented bud drop, and allowed normal opening of flowers. Shipping at 5°C was better than 22°.

Of the other research efforts concerning abscission of leaves during shipping of floricultural crops, a major portion has been for foliage species. The duration of the dark period reduced leaf quality of Diffenbachia more than nutrition or soil water content (Ben Jaacov et al., 1982). Water stress has been shown to cause leaf drop in Ficus (Peterson et al., 1981). Leaf drop was increased after dark storage when Ficus was previously grown under high light levels and fertilizer regimes indicating that acclimatization during production can be critical to shipping success. Lack of water during storage was also suggested to be critical (Poole and Conover, 1979). Ancymidol treatment resulted in less leaf drop after dark storage than untreated plants of Ficus, whereas ethephon treatments resulted in heavy leaf drop when shifted to an interior environment (Johnson et al., 1982 and Peterson and Blessington, 1982).

Our objectives for this research are:

1. To determine the carbohydrate levels of miniature roses grown under different light and temperature regimes.
2. To relate carbohydrate levels of the miniature rose plant to shipping quality parameters.
3. To determine chemical and/or environmental manipulations necessary to maintain optimal carbohydrate status for shipping high quality potted plants.

Our preliminary experiments concerning the shipping environment of potted miniature roses have shown that temperature has had a direct effect on water loss from the potted plant. Well branched plants of 'Green Ice' and 'My Valentine' in 10 cm pots were placed in cardboard containers and stored at various simulated shipping temperatures. Losses of total weight (plant, media and pot) were 10% at 10°C, 8% at 20°, 33% at 30°, and 45% at 40°. Those plants shipped at the cooler temperatures were judged to be in saleable condition after six days of simulated shipping. Those held at 30° for six days were unsaleable due to leaf loss and etiolated growth while the majority of plants held at 40° died.

The use of sealed plastic sleeves around each plant helped to prevent water loss in a similar experiment. At 35°C water loss was only 8% after six days. However, the plants were judged to be unsaleable because of fungal infestation. The 20° treatment had a weight loss of 4%. A limiting factor, however, was the tendency of the 'My Valentine' plants to produce etiolated growth. This was not a problem with 'Green Ice'. Plants of both cultivars held at 5° were in excellent condition after 6 days storage. Chlorophyll levels of the plants decreased with increasing temperature.

Future experiments are planned to investigate the use of anti-transpirants and plant growth regulators as a means of controlling water loss and etiolated growth in transit. Pre-shipping production factors, such as light quantity and duration, and fertilizer and irrigation regimes will be assessed for their impact on shipping quality primarily by studying how these environmental manipulations affect carbohydrate status of the miniature rose plant.

The demand for miniature rose plants is high and sales are generally strong when plants reach their destination without deteriorating. The development of reliable production and shipping methods will insure the continued growth in profits for producers and retailers which can be generated from this crop. Further understanding how carbohydrate levels of a flowering pot plant can influence the ability to ship it economically could have a major impact on the floriculture industry. Acclimatization of foliage plants before shipping and interior use is now commonplace. However, little work has been done towards the understanding of these relationships in regards to our more perishable flowering potted crops.

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