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PROGRAMMED PLANT DEVELOPMENT

What is the feasibility of the following scenario?

1) A deciduous tree is removed in leaf, bare-root from the production field prior to vegetative maturity;

2) It is placed in **a controlled environment sequentially programmed to produce development** of vegetative maturity and leaf abscission, to induce cold acclimation and dormancy;

3) The environment is then programmed to remove dormancy and acclimate the plant to the climate of the market area for that specific plant or group of plants.

If this scenario were followed, we would have a tree "tailored" to the market area's environment.

Moisture loss in a controlled environment can be controlled by regulating relative humidity and plant temperatures. Composition of the gaseous environment can be controlled (carbon dioxide concentrations could be regulated, ethylene concentrations could be regulated, etc). Light can be controlled with regard to photoperiod, intensity, and quality.

An area of research needing special emphasis and attention is the requirements of the woody plant after removal from the field production environment.

Extensive research has been done on post-harvest physiology and handling of cut flowers: the "Chain of Life" technology sustains quality from the time the flower is cut until its certain, soon demise.

However, there is surprisingly little research on post-production physiology of woody plants. Yet the woody plant is expected to continue to live for years. After removal from the field production environment, it must go through several developmental stages of the annual life cycle during storage and handling. It must then produce vigorous new growth several months later when replanted in the market region.

With the possibility of shipping in "unitized, closed containers" to markets via combinations of rail, truck, and ship, it is necessary to be able to specify the optimal environmental conditions for continued plant development during that period. An environment will be imposed on the plant during shipment; the imposed environment, if not specified by the grower-shipper, may be detrimental.

Add to this already complex situation the fact that the plant may be outplanted at a location having environmental conditions quite different from those of the field production area. An outplanting environment out of synch with the field production area is especially the case for exports to or from the southern hemisphere. The plant must be **adjusted for outplanting in a season out of sequence with that of the field production area.**

There is a need to do the following: 1) provide a programmed, controlled environment during the postproduction period to maintain plant vitality; 2) ensure that the plant goes through the required developmental stages; and, 3) ensure that the plant is properly acclimated for outplanting in the market area is critical.

We should not be put off by the term "controlled environment". There are degrees of control. And, the inexpensive addition of 1 footcandle of light by placing a naked incandescent light bulb in the storage area may be more critical at a given plant developmental stage than controlling temperature or light to the nth degree.

Nurserymen are already controlling storage environments of bare root deciduous plants. Consider the postproduction handling of plants at Forrest Keeling Nursery in Missouri (Steavenson, 1982). In Steavenson's words, storage can be simple or sophisticated ... ranging from heeling in bare-root stock outdoors to storage structures with controlled humidity, ventilation and temperature. "...some of the simplest procedures can be as effective as complex, expensive ones."

Storage houses at Forrest Keeling are equipped with humidifiers, thermostatically controlled exhaust fans, and a substantial portion of the storage buildings are refrigerated. "With our control of temperature, humidity and especially ventilation, Botrytis or other mold buildup is usually not a severe problem."

Storage of balled stock and container plants at Forrest Keeling is less elaborate than that for deciduous bare-root plants. The "double-tent" system of a white copolymer covered house with an inner clear poly blanket over the plants provides temperature control and wind protection..."With this system, we can see no need for using supplemental heat or the more expensive microfoam blankets" (Steavenson, 1982).

Studies conducted at Beltsville' since 1966 have shown the feasibility of using controlled environments to manage plant development. Growth has been accelerated and flowering hastened of a wide range of horticultural species including selected woody plants. Crabapple plants grown in programmed environments flowered in less than 1 year, compared to 3-4 years when development was not accelerated in a programmed environment. (Krizek, 1974).

The growth of paper birch and European white birch plants was greatly accelerated by growing them for 4 to 8 weeks during the seedling stage under controlled-environment conditions. By providing plants with a 'head start' at the seedling stage, and then maintaining them on long days, it was possible to obtain white bark on trees in 2 years rather than after 3 years (Krizek, 1972).

Hanover (1977) reported growth rates under conditions accelerating plant development were 10 times those obtainable using conventional nursery practices.

"By obtaining growth-analysis data for various crops and by developing mathematical models to describe relationships between environmental treatment and plant response, we should be able to determine the environment needed for optimum growth under controlled conditions and thereby greatly increase crop production. Despite the obvious need for programmed environments for maximum plant growth, few guidelines are available in the literature..." (Krizek, 1974).
We need to employ the powerful tools provided by **computer modeling and simulation and quantitative growth analysis** to program plant development.

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