SECTION 6
ENGINEERING, ECONOMICS, STRUCTURES AND INNOVATIONS

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Landscape Businesses and Garden Centers: Opportunities and Problems

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Nature of Work: Landscape businesses (LB) and garden centers (GC) continue to be important outlets for plant growers (Garber and Bondari, 1992; Garber and Bondari, 1995a, b). The importance of the landscape services sector in terms of employment and value added to homes have been documented in many other studies (Cox, Hollyer and Leones, 1994; Henry, 1994). The objectives of this research were to: (1) document the importance of Tennessee's LB and GC as significant sales outlets for plant material and, (2) examine the opportunities and problems faced by LB and GC in Tennessee. In the Spring of 1995, a mail survey of Tennessee plant dealers was conducted as part of a larger nursery project aimed at documenting the contribution of plant dealers to the economy of Tennessee. A questionnaire was mailed to 300 randomly selected plant dealers using a stratified random sampling technique. Plant dealers were selected from West, Middle and East Tennessee. Out of the one hundred and twenty-three questionnaires returned, fifty-six were usable. Sixty-seven questionnaires were discarded either because less than 50 % of the items were completed or respondents were neither a landscape business nor a garden center. All statistical analyses were conducted using the Statistical Package for the Social Sciences, SPSS.

Results and Discussion: Results of the survey showed that 29% of respondents operated garden centers while 32% operated landscape businesses and another 30% operated as a combination of garden center and landscape business. Most of the businesses surveyed operated as independent businesses (76%) with 14% as partnerships and only 9% as part of a corporate chain. Garden centers purchased an average of 80% of the plants they sold in 1993 while landscape businesses purchased an average of 88% of plants they used in their landscaping business for the same year.

About 54 % of customers were repeat customers for landscape businesses surveyed while only 28 % were new customers. A similar pattern was observed for garden centers where 79% of the customers were repeat buyers and 20% new customers. For both garden centers and businesses, the study showed that significant opportunities for targeting the new buyers exist. Marketing programs to specifically target new customers while keeping the repeat customers could generate additional sales for LB and GC.

The marital status of customers, as expected, showed that both garden centers and landscape businesses attracted more married customers than unmarried customers. For LB, 22 % of customers were single while 74 % were married. GC on the other hand attracted 24 % single and 77 % married customers. Again there exist opportunities for both garden centers and landscape businesses to attract the single buyers by somehow convincing them that plants add value to their property and physical environment. Value added to property by good landscaping has been documented in the literature (Henry, 1994).

In terms of age, there were no clear distinctions in terms of who should be targeted by which business. Garden Centers could probably see an increase in sales by targeting the under-30 year old customers who presently constituted only about 14% of its customers. Clearly, both the landscape businesses and garden centers could tap into a market with still potential possibilities if they targeted the slightly less educated customers. Only about 19 % of customers with less than high school education were attracted by both landscape businesses and garden centers. This group of customers represent a potential market for the landscape and garden center businesses.

Results of the survey also indicated that young customers (under-30 year olds) could provide a good source of plant material sales to the garden centers and landscape businesses. The 28% and 14% of customers in this age group attracted by the landscape businesses and garden centers, respectively, means that a strong marketing to these groups could generate big sales for the businesses.

LB and GC faced problems that supported the claim that these businesses differed in their perceptions of the problems and opportunities facing them. Perceptions of problems faced by businesses differed significantly between garden centers and landscape businesses. Table 1 shows that there were significant differences between the two business categories regarding the importance of plant spoilage and poor quality plants delivered by suppliers. GC seemed quite pleased with quality of plants received from suppliers while the contrary was the case for LB. This finding suggests that the problems facing LB and GC were viewed differently. The implication of this finding is that any strategy to address concerns in LB and GC should be tailor-made for the business in question.

Table 1. Problems Faced By Landscape Businesses and Garden Centers

Problem	Landscape	Garden Center
Lack of Information	7.7	10.0[1]
Market Uncertainty	33.3	33.3
Rising Costs	42.9	54.5
Spoilage of Plants	7.7	30.0
Poor Quality from Suppliers	23.1	9.1

[1] Considered only as second most important problem

Table 2 presents responses to what LB and GC thought were important influences on customer purchases. The numbers in the table represent percentage of respondents that cited the listed factor as most important among all other factor options given in the question or item in questionnaire.

Table 2. Factors Affecting Consumers Purchases (% Respondents ranking factor as #1)

Factor	Landscape	Garden Center
Plant Quality, Size, Color & Health	66.7	93.3
Availability of Choices	16.7	20.0
Unique Plants	16.7	8.3[1]
Plant Prices	33.3	20.0
Age, Education & Income	8.3	14.3
Timing of Supply	8.3	26.7
Location	7.7	13.3

[1] Ranked as #3 with no factor considered #1.

From Table 2, garden centers and landscape businesses differed in their perceptions of what affected consumers purchases of plants. Plant quality, size, color and health were ranked quite high by landscape and garden center businesses as factors considered to have the most impact on customers. Location and physical distribution was considered by about 8% of respondents as the most important factor impacting on landscape customer purchases while unique nature of plant was reported by 8% of respondents as the most important factor impacting on customer purchases.

Significance to Industry: It is time for plant dealers to recognize the importance of LB and GC in their overall strategy to sell plant materials. LB and GC purchased 88% and 80%, respectively, of their plant needs from plant dealers. This study identified new, unmarried, single and young customers as important groups to be targeted by GC and LB. This could lead to increased sales for the industry. This research also identified areas of problems and opportunities faced by LB and GC and offers insight on how concerns/problems of landscape businesses differ from those of garden centers. The findings of this research will help plant dealers understand the potential plant sale opportunities offered by landscape and garden centers. Plant dealers will be in a better position to understand and address problems facing two critical outlets for industry products.

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An Automated Transplanting Apparatus for Container-Grown Plants

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Nature of Work: The process of transplanting a container-grown plant from a smaller pot to bigger one remains a bottleneck in the transplanting automation. Although many efforts have been made recent years, a highly efficient automated system is still not available in the commercial market. The preliminary goad of the research was to investigate and develop an optimal and cost-effective system for the plant transplanting process. The discussion is limited within the transplanting method and the complete system will not be analyzed in the paper. The transplanting apparatus of the system has been simulated in a computer and the structure will be discussed briefly as follows.

When the container-grown plants are mature to be transplanted from the smaller containers to bigger ones for their further development, they are placed on a conveyor manually orautomatically and the plants are carried to a transplanting station where an apparatus implements the transplanting operation. The bigger containers are moved to the transplanting station on a separate conveyor to receive the transplanted plants. The arrangement of the two conveyors can be aligned, angled, parallel or perpendicular each other depending on the material location and the availability of working space. The bigger containers need to be filled with potting soil at proper density at a potting station prior to receiving plants.

The apparatus can transplant more than one plant at one operation. Four plants, for example, are placed in a positioning tray which is carried to the transplanting station. Accordingly, four bigger containers are placed in another positioning tray for the plant reception. The four plants are considered as a unit during the transplanting operation. Theoretically, one unit can contain as many plants as needed, but in practice, eight plants per unit are fast enough for a large quantity operation and easy for handling. For simplicity, single plant is used to illustrate the transplanting method in this paper, but the principles can be used as a guide for the development of a multiple-plant transplanting system. In general, a transplanting process consists of three major steps:

(1). **Remove a plant from a smaller container with a plant remover,** as shown in Figure 1. A plant remover which has three small shovels around a perimeter and a container lifter implement the task of removing a plant from small container to bigger one. The three shovels can be moved up and down simultaneously along their paths. The three shovels get closer as they are moved down and wider as they are moved up. The initial position of the three shovels is set at a desired place by using a set screw. As a conveyor carries a plant to the transplanting station where a container lifter with a vacuum cap on the top is located, the vacuum cap supports the plant container. When the lifter holds the container firmly on the bottom of the container with the suction force generated by the vacuum cap, the lifter moves the container up vertically to an upper position and at same time the three shovels of the remover dig into the root ball of the

plant from top soil along the wall of the plant container. Then the vacuum cap rotates the plant container 180 degrees clockwise and 180 degrees count clockwise to completely separate the plant root ball from the wall of the plant container while three shovels are holding the root ball of the plant stably as shown in Figure 2. Now the root ball is held by the three shovels and the container is sucked on the top of vacuum cap separately. The lifter is retracted back to its lower position with the emptied container.

(2). **Transfer a plant to bigger container.** The remover with three small shovels holding the root ball of the plant is driven to next position where a bigger empty pot below is ready to receive the plant. When the plant is immediate above the bigger empty pot, the three shovels are moved up and the root ball is gradually relieved as shown in Figure 3. Therefore, the root ball drops to a bigger container by gravity as the three shovels are off the root ball.

(3). **The remover comes back to its original position for next operation and the containers are moved to next station as a transplanting process has been completed,** as shown in Figure 4. The bigger container received a plant is moved away from the conveyor and a new bigger container is in position ready to receive another plant. The emptied pot held by the vacuum cap is replaced with a new plant as the suction force of the vacuum cap has gone. The emptied container drops to a collector.

Results and Discussion: The transplanting method described above is suitable for any size of containers and one transplanting system can be used for all plants. The diameter of the perimeter where three shovels are located is adjustable for different containers from two inches to twelve inches and the travel distance of the three shovel is adjustable, too. There are several sizes of the shovels and vacuum caps for selection to fit the dimensions of plant containers. The plant container is located very accurately with a positioner at the end of a conveyor. The positioner consists of a metal plate with a round opening in the center and a vacuum cap filled into the round opening from bottom of the metal plate to make a flat surface. When a plant container carried by a conveyor is coming to the positioner, the plant container is guided exactly to the location of the round opening in the metal plate and rests on the top of the vacuum cap which is pressed down a little bit because of the weight of plant container and the flexibility of the vacuum cap which is made of a rubber material. Particularly, when the suction force is generated in the vacuum cap, the plant container is steady sucked on the top of the vacuum cap and as the plant container is emptied, the container becomes lighter, therefore the vacuum cap lifts the emptied container up a little bit due to the elasticity of the material of vacuum cap for easy removal. The transplanting process has minimized the possible damage of the root ball of the plant since the three shovels dig into the soil along the wall of the container and no active pressure is applied on the root ball. The root ball is held by the friction between the shovels and the soil. The root ball is separated from the container by rotating the container which only generates a shearing force around the cylindrical surface of the root ball.

The structure of the transplanting apparatus is simple and inexpensive. It is easy to operate and maintain. The actuators in the transplanting operation are driven with compressed air which is available in most of the greenhouses or nursery places.

Significance to Industry: The transplanting apparatus discussed in this paper can be integrated with an existing automated system easily. They can also be developed to a fully automated plant transplanting system at a low cost which is affordable for a small size of nursery business.

There are millions of plants are transplanted from pots to pots every year in nursery industry. A highly efficient and the cost-effective transplanting will greatly relieve the labor tension and tremendously reduce the cost of the transplanting process and remarkably increase the profit of nursery business. The higher labor cost has become one of major knotty problems if a labor intensive operation is still in use as the minimum wage is increased. With the decrease of the prices of programmable controllers and the simplicity of the application of the computerized controllers, automation is the sole solution for the cost reduction and quality promotion.

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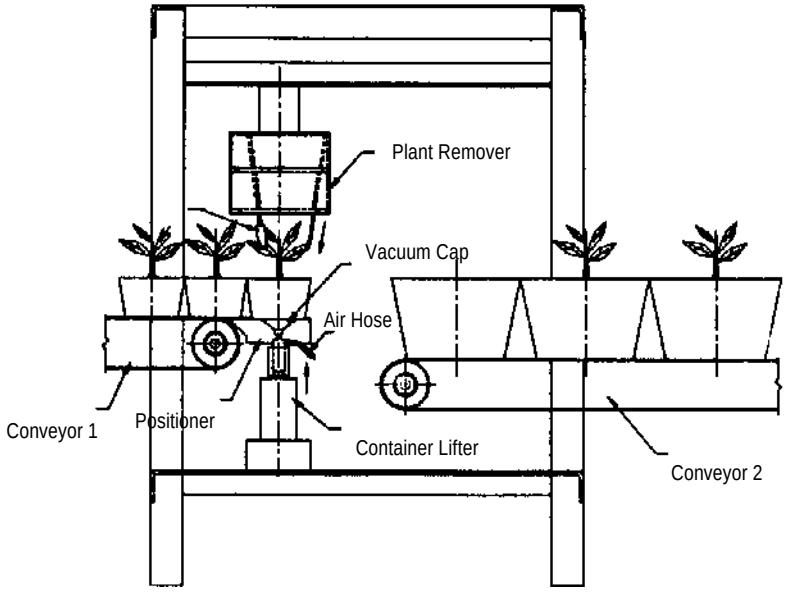

Figure 1. Illustration of a Transplanting Apparatus

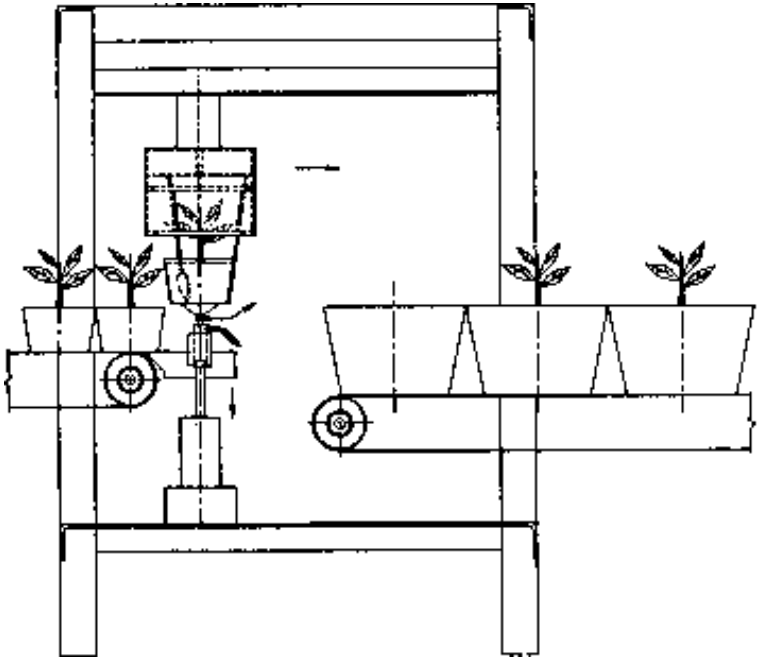

Figure 2. Separating a Plant from a Container

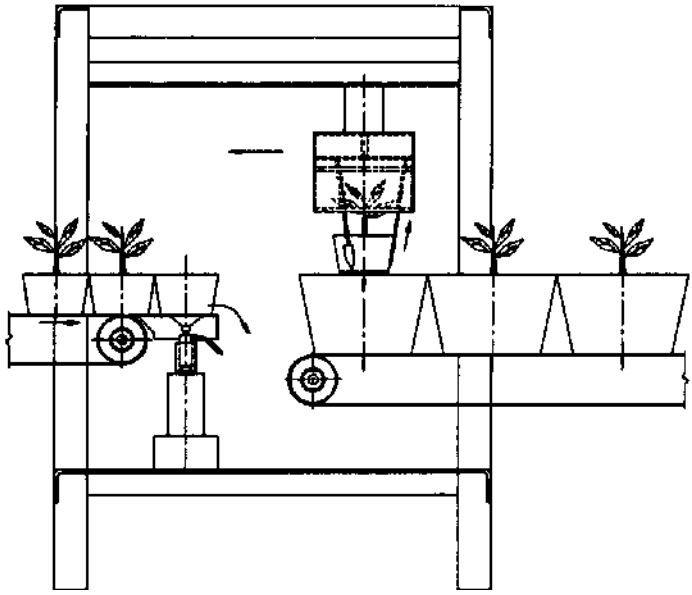

Figure 3. Transfer to a Bigger Container

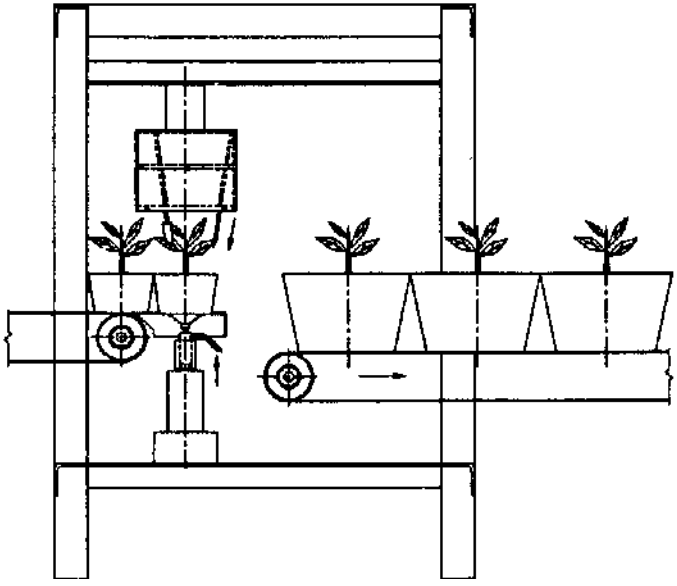

Figure 4. Ready for Next Operation