CRITICAL REVIEW

Review of Work Accomplished

The **initial** S-103 regional technical research committee (1976-1982) entitled "Economics of Producing and Marketing Woody Ornamentals in the South" was concerned with input-output relationships and costs of producing specific plant species including Kurume azaleas, crape myrtles, dogwood, forsythia, Buford holly, Pfitzer juniper, and pin oaks(Badenhop, et al., 1979; Badenhop and Wright, 1980; Badenhop and Einert, 1980; Smith, 1980; Smith and McConnell, 1981; S-103 Committee, 1979). A series of regional publications, a proceedings of a symposium sponsored by the Tennessee Valley Authority for the American Association of Nurserymen, and other publications have reported results of this research. In these documents, the advantages of various production regions in competing for markets were delineated. Data relating to prices, product mix, distribution patterns, and other characteristics of marketing were analyzed, along with sales invoices from representative samples of nurserymen (Free and Vitelli, 1979; Gamble, 1979; Massey, 1979; Phillips, 1979; Einert, 1979; Badenhop, 1979; Smith and McConnell, 1979; Smith, 1979; McNiel, 1979; Wright, 1979; Crafton, et al., 1982).

The **second** authorized S-103 project (1982-1987), "Economics of Producing and Marketing Woody Ornamentals" focused on physical and economic modeling of both container and field nurseries in USDA Plant Hardiness Zones 5 and 6 (Northern States) and in USDA Plant Hardiness Zones 7 and 8 (Southern and Southeastern States) using economic-engineering techniques (Badenhop and Phillips, 1983; Taylor, et al., 1983; Dickerson, et al., 1983; Badenhop, et al., 1985; Badenhop and Glasgow, 1985; Crafton and Phillips, 1984; Phillips, 1984; Crafton, et al., 1982; Perry, et al., 1987). Production depicted by these model nurseries represented the vast majority of the dollar volume of nursery sales from these production regions. Cost differences among species were determined to be caused primarily by differing space requirements, length of production cycles, cost of liners, and over-wintering needs. While the previous studies were not completely comparable because of differences in species studied, year of study, size of plants and assumptions, basic analysis of the data clearly showed cost-of-production advantages for the South.

Profitability of firms in the landscape nursery industry (growers, wholesalers, retailers, repackers and rewholesalers, contractors, etc.) is directly associated with competitiveness in production and in the marketplace. Hence, competitiveness can be measured at the regional level as well as among individual firms. Cost leadership is but one factor influencing the competitive advantage of a production region and/or firm (Coutu and Vitelli, 1979; Phillips, 1979; Free and Vitelli, 1980; Vitelli and Free, 1980; Hinson, 1983; Phillips and Badenhop, 1983; Phillips, 1984), although previous research efforts concentrated on developing baseline cost-of-production data.

Marketing research focused primarily on transportation and distribution of plant material from state to state or region to region (Badenhop, 1981; Doerer, et al., 1982; Williams and Musillo, 1984). Economic analyses and studies of marketing strategies used by industry firms were also conducted (Smith and McConnell, 1979; Phillips, 1984). Although comparative advantage evaluations were conducted between production regions and representative states producing landscape plants, ultimate success by any particular business still hinged on the micro-economic environment within that firm (Gunter, 1979; Hymum and Phillips, 1979; Trieb, 1979; Phillips and Ward, 1980; Smith and McConnell, 1981; Perry and Badenhop, 1982; Crafton and Phillips, 1984).

The **third** research effort (1987-1993) conducted by the S-103 technical research committee

entitled "Technical and Economical Efficiencies of Producing and Marketing Landscape Plants" focused on five interrelated issues. These topics included: (a) budgeting and economics, (b) technical production aspects, (c) firm management, (d) marketing, and (e) interregional competition. Each topic will be discussed separately.

Previous budgeting and economics work by the S-103 committee (1976-1982 and 1982-1987) concentrated on the development of enterprise budgets estimating the cost of producing specific landscape plant species. This approach was expanded and modified into whole-firm modeling utilizing economic-engineering and operations research procedures. The 1987-1993 research effort expanded the scope of analyses in three ways. First, budgets were developed and costs estimated for representative container and field nursery production firms in selected USDA Plant Hardiness Zones, a stratification previously not studied nor reported. Examples of the economic results (Hall, et al., 1987; Phillips, 1989; Perry, et al., 1990; and Foshee, et al., 1990) provided a baseline of economic data observations (capital costs, labor and equipment requirements, operating expenditures, and firm and species profitability) differentiated by size of firm and species of plants stratified by latitudinal plant hardiness zones, which eliminated duplication that would result from a state-by-state approach. Second, the types of landscape plant products studied were expanded to include diverse production systems, such as turfgrass, perennials, and tissue culture, as well as container-grown, field-grown, and greenhouse-grown landscaping plants (Kizer, et al, 1987; Hall, et al., 1987; Taylor, et al., 1990; and Stegelin and Powell, 1991). Third, the industry sectors analyzed from a budgeting perspective were expanded beyond wholesale growers to include landscape contractors, landscape maintenance firms, and retail garden centers (Barton, et al., 1992). The procedure used for this work was to analyze existing firms recognized as leaders in their respective sectors in order to construct hypothetical firms with representative costs to permit economic comparisons and development of economic guidelines. While considerable progress was made, additional costs and returns studies are needed because of the diverse nature of the greenhouse/nursery industry.

Technological advances in the landscape plant industry have impacted production practices of nurserymen economically and procedurally. With the development of new technology resulting from either scientific advances, legislative edict, changes in consumer and marketing demand, or environmental policy concerns, horticulturalists and agricultural economists participating in S-103 cooperatively conducted several analyses of the applications and economic worthiness of these technologies in the landscape plant industry. Specific studies analyzed biological control of insects, water-efficient pelletized container production systems, water holding capacity of various potting media, pelletized tree production, grow-bag in-ground plant production, alternative irrigation methods, and alternative weed control strategies (Hood, et al., 1987; Taylor, et al., 1989; Tinga, 1988; Aitken, et al., 1990; Alverson, et al., 1990; Eakes, et al., 1990; Gilliam, et al., 1990; Eakes, et al., 1991a; Eakes,et al., 1991b; Briggs and Green, 1991; Robbins, et al., 1991; and Roberts, 1991). While considerable progress was made, continuing pressure for environmental consciousness and for firms to remain financially competitive necessitated the need to continue the study of alternative plant production and maintenance systems.

The predominance of decision-maker, problem-solver, management-oriented research conducted and published during the tenure of S-103 has had firm-level emphasis affecting the economic "bottom line" of producers and marketers of landscape plants. Issues addressed by the technical research committee include optimal product mix, cash flows, pricing strategies, and computer applications (Kizer, et al., 1987; Phillips, 1988; Hall and Phillips, 1989; Phillips and Hall, 1990; Rhodus and Taylor, 1990; Hall and Phillips, 1990;Turner, 1990; Phillips, 1991; Hall and Phillips., 1991; and Barton, et al., 1994). Additional research was needed to extend the information available to industry participants regarding management of biological systems, production technologies, and resource protection and management.

Published marketing research by S-103 committee members has also had a predominant emphasis on the competitive nature of the marketplace and firm management and marketing strategies that take advantage of opportunities available to the firm or region. In part, the status of the general economy influenced this shift in research agenda. As such, the structure, conduct and performance (industrial organization) of the industry were the attention of studies of the competitive market situation and environment (Taylor, et al., 1989; Turner and Stegelin, 1989; Ames, 1990; Behe, et al., 1990; Hodges and Haydu, 1990; Phillips, et al., 1990; Bauer and Brooker, 1991; Brooker, 1991). Several states either completed studies to estimate the aggregate economic impact of the turfgrass industry or to examine the marketing practices of turf producers (Adrian, et al., 1985 and 1986; Stegelin and Powell, 1991; and Adrian, et al., 1992). Continuation of this work is critical to the development of benchmark data for use in analyses of adjustments in the industrial organization of the nursery industry and to perform cross-sectional marketing analyses. ditional marketing research focused on the consumer, including purchase expenditures, buying patterns, product selection and other purchasing behavior (Ames and Einert, 1987; Gineo and Omamo, 1990; Turner, 1989; Gineo, 1989; Turner and Fletcher, 1989; Turner, et al., 1990; Turner and Dorfman, 1990; Hall, 1991; Johnson, et al., 1991; Stegelin, 1991; Turner, 1991; and Turner and Dorfman, 1991).

Analyzing interregional the trade flows and marketing practices of landscape plant producers throughout the United States was a primary objective of the 1987-1993 S-103 project. All states with technical committee representation participated, along with solicited assistance and participation in many other states. The primary summation report was published as a Southern Cooperative Series Bulletin (Brooker and Turner, 1990). Several cooperating states published individual reports (Brooker, 1989; Brooker and Bryan, 1989; Bryan and Brooker, 1989; Adrian, et al., 1990; and Stegelin and McNiel, 1990), including some publications cited in the earlier marketing section. The competitive relationships among states and regions continues to be a major issue as business managers make financial and marketing decisions regarding future investments and economic strategies.

The **fourth** research effort (1993-1998) conducted by the S-103 technical research committee ("Technical and Economical Efficiencies of Producing, Marketing, and Managing Environmental Plants") had three stated objectives: (1) evaluate alternative landscape (environmental) plant production, establishment, and maintenance systems, (2) evaluate the regional competitiveness within the landscape (environmental plant) industry, and (3) evaluate the demand for landscape (environmental) plants, materials, and services. Work accomplished pertaining to each of these objectives is discussed separately.

Objective 1: Evaluate alternative landscape (environmental) plant production, establishment and maintenance systems.

Plant production research included the evaluation of the economic feasibility of growing selected tree species to larger sizes (Tilt, et al., 1994a). The closed, insulated pallet system (CIPS) is an innovative plant production system designed to reduce nursery industry problems with water runoff (Briggs and green, 19940. Research with CIPS has indicated that Phytophthora cinnamomi does not spread from inoculated to noninoculated root pouches. Over 40 genera of plants have grown equally well or better in CIPS compared with open container systems (OCS). Container nursery production is more profitable in CIPS than in OCS. Establishment and maintenance of beneficial microorganisms, such as Trichoderma harzianum is enhanced in CIPS. Water and fertilizer use in CIPS is approximately 90% less than that applied in the overhead irrigated open container systems. There is no fertilizer or irrigation water effluent from CIPS. Plants are more tolerant of saline irrigation water in CIPS (Green, et al., 1993).

Relative costs and returns for selected plants grown using infield, above-ground container and

pot-in-pot production methods were evaluated for a 10-acre nursery with a five acre production area and a three year growing cycle. Pot-in-pot systems had high initial capital outlay which resulted in higher fixed cost per plant. However, less intensive cultural practices and increased plant numbers resulted in the lowest per plant cost for the alternative system (Tilt, et al, 1994).

Several projects were completed that evaluated alternative plant production regimes. These included an economic analysis of Arizona Ash sequentially produced in copper-treated and non-treated containers (Obst, et al.,1996), a determination of optimal marketing strategies for container-based production systems (Stokes, et al., 1996), an evaluation of the production of turfgrass-sod as an alternative farm enterprise (Adrian, et al., 1996), an evaluation of stock plant etiolation and shoot age effects of histology and adventitious root formation in stem cuttings of Carpinus betulus L. 'fastigiata' (Maynard and Bassuk, 1996), an evaluation of the economic feasibility of micro irrigating container grown plants (Haydu and Beeson, 1997), an analysis of the growth and development of euphorbia pulcherrima and pelargonium x hortorum in shredded rubber-containing substrates (Baquir and Harkness, 1997), and estimating the cost of producing container-grown landscape plants with the assistance of computer accounting software (Foshee, et al., 1997).

In addition, studies are nearing completion on turf response to an N release from new coated urea fertilizers (Williams, et al., 1997), greenhouse production and landscape responses of petunia and pansy to copper coated containers, cell size, and extended production schedules (Arnold and Lang, 1997), the impacts of copper leaching from Cu $(OH)_2$-treated containers on water recycling, nursery run-off, and growth of bald cypress and corn (Arnold, et al., 1997). Furthermore, the effect of low water quality and quantity on container plant production was evaluated (Green, 1996), as was the efficacy of using Ethephon during New Guinea impatiens production to delay flowering (Burney and Harkness, 1997). Another recycling study evaluated using calcium carbonate to reduce zinc toxicity in media containing shredded tires, while container production of small trees under kenaf and coconut coir pith was analyzed (Goyne and Arnold, 1996). Finally, an evaluation of rooting rhodendendron without mist was completed (Holt, et al., 1996) and using stock plant shading to increase rooting of paperbark maple cuttings was investigated (Maynard, et al., 1996).

Several projects were completed that evaluated alternative production systems. Chrysanthemum cultivars were shown to respond negatively to shredded tire rubber in the growing medium (Britt and Harkness, 1997). Cultivars bred for greenhouse pot plant culture had leaf tip burn after 5 days in the media and were dead within two weeks. Cultivars bred for use as fall garden mums tolerated the rubber at 10% application levels but never grew as large as the controls. Geraniums were also grown in the shredded rubber media under drip, hand, or ebb and flood irrigation. Leachate samples were collected bi-weekly and were analyzed for pH, soluble salts, and zinc content. At the end of the experiments, foliage samples were also collected and analyzed for mineral content. Another project examined the economics of pulsed cyclic micro-irrigation in container production (Haydu and Beeson, 1997). With water issues rising to increased prominence in Florida, examining the efficacy of alternative technologies provides useful information for nursery growers, the industry and policy makers.

A survey of greenhouse managers has been conducted to determine products produced and the use of various production technologies. These variables might be associated with firm size (TN). The data assembly was begun to update research on costs of producing selected floricultural crops in Climatic Zones 7 and 8. The previous research is 15 years old and needed to be revised as to crops and greenhouse and plant production technology (Brooker, et al., 1996). An evaluation of post-transplant root regeneration and field establishment of container-grown Shumard Oak through mechanical correction and chemical avoidance of circling roots (Arnold, 1996) was completed. A comparison of seed rate, spacing and weed

control methods in a Virginia meadow (Harkness and Lyons, 1997) was also completed. Research in the adaptability of native grasses for southeastern humid conditions has resulted in the evaluation of Buffalograss (Buchloe dactyloides) cultivars Texoka and Topgun at 23 cm spacing and 23 and 30 cm spacing, respectively. Seedling little bluestem (Schizachyrium scoparium) at 11.2, 27.4 and 48.8 kg plants/ha provided an acceptable stand when measured visually at any of the rates. Four cultivars of little bluestem (SCS#9029926, Pastura, Aldous and Cimmeron), 'Alamo' switchgrass (Panicum virgatum) and 'Haskell' sideoats grama (Bouteloua curtipendula) were studied (Aiken, 1995). SCS# and 'Aldous' little bluestem cultivars were superior to the other little bluestem cultivars in plant height and coverage. 'Alamo' switchgrass was much taller and thicker than all the other grass cultivars. The sideoats grama was the shortest of the species.

The comparison study of little bluestem cultivars and 'Alamo' switchgrass completed the second year in the field. 'Alamo' switchgrass is the dominant grass in this study with the seeded plots significantly taller than the transplanted plots and all of the little bluestem cultivar plants both seeded and transplanted. Percent plant coverage was not significantly different between switchgrass and little bluestem cultivars SCS 9029926 and 'Aldous' but was different from little bluestem cultivars 'Pastura' and 'Cimmeron.' Biomass data shows the switchgrass significantly greater than the other species. SCS 9029926 little bluestem cultivar seeded and transplanted was the best of the bluestem cultivars in each of the growth indices. Seeding the species tended to produce a better stand and growth than transplanting in each of the cultivars. Application of Plateau and Roundup herbicide significantly reduced growth of bahiagrass and suppressed seedhead development and suppressed seedhead development for 8 weeks after application (Aiken, 1995).

A host of articles were published concerning pest management in the greenhouse and nursery industry and for landscape maintenance firms (Garber, et al., 1996a; Garber and Hudson, 1996;Hudson, et al., 1996; Garber and Bondari, 1996;Garber, et al.,1996b)) (GA). Auxiliary articles were published on chemical (Garber, et al., 1996c), disease (Garber, et al., 1996d), insect (Norcini et al., 1996), and weed control (Gilliam, et al., 1990). Another project has evaluated the use of copper paints and copper-treated burlap for the control of rooting out in B&B nursery stock during holding in wholesale and retail yards (Maynard, 1997). In addition, copper polymers are being evaluated for use in controlling circling of plant roots within containers(Maynard, 1997).

Objective 2: Evaluate the regional competitiveness within the landscape (environmental) plant industry.

Nineteen states from within the project and 5 additional states cooperated to conduct an ornamental plants trade flow survey designed as a follow-up to the 1989 survey. After input from committee members to improve the survey instrument the survey was mailed to certified nurseries in 24 states. Using the Dillman approach (which consists of mail out, follow-up postcard, and remailing the entire package to those who have not responded, within a specified time frame), a response of about 1,350 usable questionnaires was achieved. “Trade Flows and Marketing Practices within the United States Nursery Industry”, was published in hard copy and on the World Wide Web (Brooker, 1995)

Using a landscape/retail nursery firm case as an example, the use of employee empowerment to increase productivity and to assist in managerial control was studied. The firm's objective was to release owner time for design and sales activities, while using empowerment of hired managers to maintain profitability and the firm's image as a high quality supplier of services and plants. In the first year, communication to managers and other employees about empowerment and its responsibilities, combined with insufficient control and a declining economy led to a deteriorating financial condition for the firm.

Subsequently, communications and personnel turnover, combined with budgeting for control, restored profitability. The case illustrated that a management information system must be available as feedback. Then the empowerment concept can allow decision-making to flow toward the point where work takes place (Hinson and Ackroyd, 1994).

Change of product ownership in competitive agricultural industries is a critical event, yet little research has examined the transaction methods used by firms and the corresponding factors that influence the choice of transaction method. A sample of landscape plant nurseries across the U.S. provided data to model this decision. Transaction methods included sales by telephone, personal visits, mail order, and at trade shows. In addition, factors that influenced negotiated sales were investigated. Influential factors included age of the business, size (as measured by gross sales), location, market channel use, ownership structure, and perspective on competitive situation. Using a tobit estimation procedure, profiles of nursery firms more likely to use a particular transaction method were developed (Hinson, et al., 1995).

Two surveys of the Tennessee nursery industry completed in 1989 and 1994 focused on plant sales to three types of market outlets and the destination of these shipments by state (Brooker, 1996). Wholesale sales accounted for 89% and 93% of annual sales in 1988 and 1993, respectively. With respect to re-wholesalers, the percentage of annual sales to states in the southeast and northeastern regions declined, but sales to re-wholesalers in the north central states and the south central states increased dramatically. The distribution of annual shipments to landscapers decreased in the northeastern region and increased in the north central region. The share of wholesale sales to Tennessee landscapers remained about the same. The major north central states are Kentucky and Ohio. The larger volume states in the northeastern region are Maryland and Virginia. Shipments to out-of-state retailers increased to other southeastern and north central states, but declined to states in the northeast region. In contrast to wholesale sales to landscapers and re-wholesalers, the percentage share of shipments to outlets in Tennessee decreased from 15 to 4 percent. A study was completed which investigated the tax implications resulting from various nursery organizational structures and product mix scenarios. The impact of "holding over" containerized nursery stock for future sale as larger sized plant materials was assessed. (Stokes, et al., 1996).

An evaluation has been conducted of the feasibility (competitive position) of alternative warm season turfgrass-sod species: bermudagrass, centipedegrass, and zoysiagrass. Analysis are based on budgets developed for south Alabama which would be representative of USDA Plant Hardiness Zone 8. These data were entered into a multiperiod linear programming model to evaluate optimal combinations of grasses to maximize net return over a seven-year planning period. These data were also used to evaluate the feasibility of turfgrass-sod production on an on-going farm operation in this region (Adrian, et al., 1995).

Louisiana trade flows of woody ornamental plants was compared between 1988 and 1993. By kind, the customer base diversified (smaller proportion of sales to each kind of customer) for retailers and rewholesalers, while the portion of sales to landscapers increased. By destination, nurseries with in-state share of sales between 25% and 75% increased from 47% to 93% while in-state sales greater than 75% declined. The west south central region (including Texas) became more important. These changes reflect that in 1988, a national economic slowdown was occurring which worsened a concurrent decline in crude oil prices, and industry wide expansion of production was marketed during the slowdown, intensifying competition (Hinson, 1996).

A study was also completed on out-of-state sales by U.S. landscape plant producers to investigate influential factors (Turner, et al., 1996). The impact of competition and structural change on Florida's ornamental plant nursery and golf course industry was evaluated (Haydu, et al., 1996). In addition, the economic contribution of Florida's and Louisiana's turfgrass industry was evaluated (Haydu, et al., 1996;

Hinson and Hughes, 1997). Using data from the 1989 and 1994 S-103 national marketing surveys, the southern states market share was evaluated (Brooker, 1996) as were trade flows between states (Brooker, 1996), nurserymen's marketing practices (Brooker, 1996), and factors perceived to limit growth (Brooker, 1996).

Objective 3: Evaluate the demand for landscape (environmental) plants, materials and service.

The size and impact of the nursery/landscape industry was evaluated with a variety of tactics (NV, GA, NC, TX). A national data base of number of retail garden centers has been used to estimate population thresholds. This project uses count data procedures for estimation of thresholds. This potentially will produce better results than the ordinary least squares procedures. Count data procedures have been extended to incorporate dependency between numbers of garden centers and number of other retail shops. These procedures will incorporate retail shop dependency (Deller and Harris, 1993).

A two-year study was completed that investigated the size and scope of turfgrass-related industries in Texas. This project analyzed the amount of turf and nursery products that are produced in the state, the amounts and value of inputs used in the production/distribution of turfgrass, and the value added to these products as they move through the marketing system. An input-output modeling approach will be used to determine the full economic impact of the turfgrass industry in Texas (Lard and Hall, 1996). In an analysis of the competitive relationship of three warm-season turfgrass species, variation in the prices of the different grasses had little impact on the profit maximizing combination of grasses within current observable price ranges. Bermudagrass, with its shorter production cycle and positive influence on cash flow, dominates the higher-valued, longer production-cycle grasses (Adrian, et al.,1994).

The importance of the green industry in the United States economy is being investigated. The goal of the study is to describe the relative size of this industry in terms of employment, output, and value added. A similar study has been completed for the Georgia economy. Results indicate that within Georgia production agriculture, the green industry ranked second in terms of employment, third in terms of output (annual gross sales), and third in terms of value added (Turner and Kriesel, 1994). Data describing the status and nature of Alabama's ornamental plant industry were also summarized and published (Behe, et al., 1990). The contribution of the Green industry to the Louisiana economy was determined. A $1 increase in sales by producers resulted in a $1.4291 multiple in economic activity when household spending was excluded, and by $1.9930 when household spending was included. Similar multipliers for landscape/horticultural services were $1.4907 and $2.8920 (Hinson and Hughes, 1997).

The following two publications have been revised to include current data (DC): Statistical Bulletin 817, *Floriculture and Environmental Horticulture Products, a Production and Marketing Statistical Review, 1960-88.* Statistical Bulletin 862, *Financial Performance of U.S. Floriculture and Environmental Horticulture Farm Businesses, 1987-91* (Johnson, 1990). The relative size of the green industry within the U.S. economy and how it is linked to supporting industries through the volume of transactions and economic impact multipliers was examined. This analysis was based on IMPLAN, an input-output model developed by the U.S. Forest Service. In terms of 1990 employment, the green industry was the second leading employer in U.S. production agriculture. In terms of output, the greenhouse and products sector ranked sixth within production agriculture (Turner and Kriesel, 1995). A survey of the commercial members of the Perennial Plant Association (PPA) indicated that gross sales of perennials by PPA members for 1994 was an estimated $1.38 billion, with 29% of this amount generated from sales of perennial plants. Sales of perennials increased over 1993 levels for 86% of all respondents. The most popular genus sold in the U.S. for 1994 was Hosta, followed by: Hemerocallis, Coreopsis, Chrysanthemum, and Astilbe (Rhodus and Hoskins, 1995).

A review of the current literature on consumer preferences for plant materials from retail outlets is in progress. Sections will include an introduction with an overview of the economic impact of the green industry, an overview of market research in individual states, general demographic data on garden center consumers, a summary of consumer preference research and an overview of the landscape industry as it relates to preferences of retail consumers (Barton, et al., 1997). A grant was received from the Bedding Plants Foundation, Inc. to investigate consumers' decision-making process and preferences for geranium by simultaneously defining the importance of and preferences for (1) flower color, (2) leaf variegation, and (3) price (Behe, et al, 1997). Consumer research was conducted in garden centers to investigate preference s for geraniums by asking the flower color, leaf variegation, and price combinations (viewed in photographs on display board) they would or would not purchase. Red and lavender were the preferred colors, while zonal and plain were the most preferred leaf variegation, and low prices were preferred. A simulated blue geranium was not popular as it consistently ranked in the lower third of the preferred combinations. Another product demand that was investigated using focus groups was windflower sod (Barton, et al., 1996). The demand for ornamental products in North Carolina was also investigated (Abdalmagid, et al., 1996). Two focus groups (homeowners, landscape professionals) were used to study the acceptance of wildflower sod as a landscape product. The reaction of both groups was positive. Homeowners believed the wildflower sod to be an interesting product for relatively small spaces (Barton, et al., 1996). The own price and income elasticities of the largest selling plants and shrubs are being estimated. Lesser selling plants will be grouped by general categories to estimate their elasticities ((Abdelmagid, et al., 1995).

A study on the impact of population threshold levels on rural nursery retail businesses found that less population was required if other retail firms were present (Shonwiler and Harris, 1996). A North Carolina study explored factors that influence a consumer’s selection of a garden center (Safley and Wohlgenant, 1995), while a Georgia study examined customer defections (Stegelin, 1996). Another effective tool to assist retailers of landscape material is image assessment. This was used in Texas to determine image and reputation in a local trade area (Hall, 1996). New studies that assess the image of competing retail garden centers within local trade areas are underway. The survey instrument used for primary data collection has been refined based on feedback from previous surveys. It is anticipated that a compilation of consumer perceptions may be extrapolated to provide regional trends regarding customer perceptions of retail garden centers (Hall, 1996).

Research revealed that consumers preferred poinsettia cultivars when compared to other colors (Behe, et al., 1997). Consumer preferences for geranium flower color, leaf variegation, and price in five U.S. markets were investigated and again red was the preferred color (Behe, et al., 1997). Lagerstroemia 'Victor' and 'Zuni' were studied for use as a potted florist crop (Rawson and Harkess, 1997). Experiments were conducted on number and timing of pinching, fertilization rate, and photoperiod response. Pinching and timing of the pinch did not significantly affect the overall size or shape of the plants. Planting 3 liners per 15 cm diameter container provided a larger plant than only 1 liner. The plants are photoperiodic requiring long days for vegetative growth and flowering. Growing the plants under 4 to 8 weeks of short days before moving into long days resulted in the highest quality plants. Applying 200 mg/l N from a 20-10-20 liquid feed once per week or 6 g of 15-11-13 slow release fertilizer resulted in optimum plant growth. Another project is evaluating the growing and marketing requirements of new sustainable plant species for introduction to the nursery industry (Maynard, 1996).

Following up on a study of the demand for labor in Florida's turfgrass industry was an examination of associated labor issues affecting turf-related enterprises (Haydu and Hodges, 1996). A similar project developed a business management oriented teaching case for a small nursery and landscape business (Hinson, et al., 1994). The focus was on an employee empowerment program that moved decision-making closer to the work site. The case used balance sheets and owner description of objectives and

implementation to show the firm's changing managerial structure in its attempts to encourage employee initiative and entrepreneurship, thus capturing the potential advantage of a decentralized management style. The case suggests caution since not all managers want to be in an empowered environment, and the learning curve in implementing this system may be a significant factor. Turf acreage and maintenance costs conducted by various states were summarized by the major strata. This data will serve as a basis for estimating the size and relative importance of the US turfgrass industry (Stegelin,and Powell, 1991; White, et al., 1991; Adrian, et al., 1992; Hinson and Hughes, 1996; Haydu, et al., 1996; Lard and Hall, 1996). The demand for labor in Florida's turfgrass industry was evaluated (Cisar and Haydu, 1991).

Research was conducted on consumer perceptions and expectations of garden center products service quality (Hudson, et al., 1997). Another project investigated the stability of target markets for landscape plants over a nine year period (Turner, 1997). The different outlets analyzed in this study were large retail stores (Kmart, Walmart, etc.), large lawn and garden centers (Pikes, etc.), and local lawn and garden centers. Economic models were developed to identify factors that would explain the percentage of plants purchased at different outlets. Each equation was estimated using a tobit procedure. The results confirm previous results that different target markets exist for different types of retail outlets for landscape plants.

A World Wide Web site on the Internet was developed during 1995 to disseminate research findings and general program information related to the S-103 Regional Research Committee. Titled, "EnviroPlants Research," this site carries a complete description of the project objectives, project participants, and results of the 1994 survey that documented trade flows and marketing practices within the United States nursery industry for 1993. Additional publications and links to other Internet resources are also available. The URL address for this site is: http://hortwww-2.ag.ohio-state.edu/s103/s103.html.

Degree to Which Objectives Have Been Accomplished

Considerable progress was made with the first objective. Production-oriented studies have contributed to the success in meeting the goals established under this objective. Also, the modeling of production systems to represent landscape plants grown in the various hardiness zones yielded baseline data for some plant categories and resulted in revisions of earlier economic engineering studies. However, the vast number of different horticultural products, continuing technological advances, and increasing environmental concerns, all preclude the possibility that this objective could be completely fulfilled.

Because of relatively new territory covered by marketing and demand analysis in the landscape (environmental) plant industry, the need is still sizable. The survey work and evaluation of structural issues and alternative marketing systems provides a solid base for expanded evaluation of wholesaling and retailing issues. The numerous publications associated with this objective reveal that a great deal of work was accomplished during the project period. However, product complexity with regard to grades, the issue of price discovery, and the need for reliable estimates of demand and supply elasticities leave much opportunity for further research.

Areas Needing Further Investigation

The exceptional growth experienced by the nursery/greenhouse industry during the 1980s presented renewed interest by nurserymen in the profitability of firms in the landscape nursery industry, which includes growers, wholesalers, retailers, repackers, and landscape contractors. Basically, profitability is derived largely from the competitiveness in production and in the marketplace. Cost leadership is but one

factor influencing the competitive advantage of a production region and/or a firm, although previous research efforts primarily concentrated on developing baseline cost-of-production data as the logical first step to broader, market competitiveness analysis.

Farmers of traditional agricultural crops are investigating horticultural crops as an alternative enterprise. Additional production studies and the impact of increased supplies on the competitive relationships between states and regions needs to be examined. Competitiveness can be measured at the regional level as well as among individual firms. Insight provided by programming models can help industry participants, both growers and marketers, make better decisions regarding long-run investments. If major economic forces that are going to readjust the sources of primary supplies in the long run can be anticipated, then industry participants and public agencies working with this industry will be in a better position to make economically rational decisions.

Marketing of landscape (environmental) horticultural products continues to be a challenging issue. Additional insight regarding the purchasing behavior of consumers should help retailers, wholesalers, and producers to satisfy the desires of consumers. While several S-103 studies have focused on consumer demand, market demand analysis is still relatively new in the horticultural products area. The absence of time series data adequate for price and demand analysis necessitates the collection of primary data. A third nationwide survey of nurserymen is needed (and is underway) to be able to measure structural changes occurring within the nursery/greenhouse industry. Additional surveys of consumers, landscape firms, and retailers need to be conducted to support analyses of the changing structure, behavior and performance of firms comprising these subsectors of the overall landscape (environmental) plant industry.

A continuing and difficult question concerns the potential for growth by state and by region. The apparent regional advantages or disadvantages resulting from population shifts, climatic differences, lower resource prices, containerization, etc., must be incorporated into studies of interregional competition and competitive advantage. Evaluation of the individual firm's adjustments and the overall structure of the industry should benefit nurserymen and consumers, as well as contribute to enhanced efficiency in the allocation of resources from a macro perspective.