

An Overview of the Current State of Human Issues in Horticulture in the United States

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SUMMARY. Throughout history, plants have been used to benefit people. In the United States, formal research to document the impacts of plants on people was not published until the 1970s, when papers from social and medical scientists began to appear. In the 1990s, symposia, including the first on "The Role of Horticulture in Human Well-being and Social Development," brought people together from around the world to share and expand their knowledge in this emerging field. Symposium participants have included researchers in the social sciences and plant sciences, practitioners in horticultural therapy, teachers in colleges and public gardens, industry representatives applying the knowledge, and more. This has formed the basis for current activities in research, teaching, and practice throughout the United States. Examples from research that now documents a variety of beneficial impacts of plants on people are discussed.

People historically have been much more connected to plants and nature than many of us in industrialized areas are today (Iltis, 1973). The common use of plants by everyday people in 79 AD was frozen in time when Mt. Vesuvius erupted and enshrined the city of Pompeii (Jashemski, 1979). Many different tribes of Native Americans in the United States clearly understood the role of nature in their lives. In fact, gardens and food crops are a central part of their spiritual heritage (Buchanan, 1997). In modern history, we can find many written reports extolling the positive impacts of plants on people's lives (Burlingame, 1954; Menninger, 1948; Rush, 1812).

The need for research on the impacts of plants on people is relatively new. In the past, when people were more directly connected to nature, they did not have the need to validate these impacts with research; the benefits were obvious to them. The attitude that the value of plants and nature does not need to be documented with research remains today among many Native Americans.

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They would consider it an insult not to accept the knowledge of the relationships between plants and people that has been passed down from their ancestors in the form of ancient and traditional wisdom (A. Krush, personal communications). Among others in the United States, formal research to document and isolate many of the impacts of plants on people began to appear in the 1970s with a few research studies from social and medical scientists (Kaplan, 1973; Talbott et al., 1976). Some horticulturists and botanists also began expressing the importance of the field (Cotter et al., 1978; Iltis, 1974; Lewis, 1973, 1976).

By the 1990s, symposia, including the first on "The Role of Horticulture in Human Well-being and Social Development," brought people from various disciplines around the world together to share and expand their knowledge in this emerging field (Relf, 1992). Symposium participants have included researchers in the social sciences and plant sciences, practitioners in horticultural therapy, teachers in colleges and public gardens, business and industry representatives applying the knowledge, and more. These symposia now are held every 2 years, and proceedings from the presentations are available (Burchett et al., 1999; Flagler and Poincelot, 1994; Francis et al., 1994; Williams and Zajicek, 1997). The next symposium is scheduled for 20–22 July 2000 at the Chicago Botanic Gardens, Chicago, Ill. These have fostered many of the current activities in research, teaching, and practice in the United States.

In this paper we will present examples from current activities in human issues in horticulture, focusing on recent research. We will not attempt to provide a comprehensive review of this rapidly expanding field. Interested readers may use these as a springboard for getting further into the topics.

Research foundation for impacts of plants on human well-being

The disconnection between nature and people in modern life, combined with the economic pressure to only value what has monetary worth, may have contributed to the need to document the impact of plants on people. In the United States, in particular, this seems to have been a factor

in the first studies conducted. The U.S. government funded many of these early studies that have formed the theoretical basis for much of the work that has followed.

For example, from the 1950s through the time of the first Earth Day in 1970, the U.S. Forest Service was receiving increasing pressure from the emerging environmental and recreational movements to value forests for what they give in addition to boardfeet for lumber (Dana and Fairfax, 1980; Steen, 1976). The Forest Service had no idea how to calculate the value of different parks or potential park sites, other than by calculating how much lumber could be made if the trees were cut down. As a result of this mounting pressure to calculate different values, they funded social scientists to examine the importance of views to people. This work led to the study of landscape preferences. Many of the studies by Stephen and Rachel Kaplan, environmental psychologists at the University of Michigan, were funded by this source (Kaplan and Kaplan, 1989). The landscape preference theories have contributed to further studies on the role of plants in mental restoration from fatigue and in stress reduction.

One of the people who worked briefly with the Kaplans was Roger Ulrich, who earned his doctoral degree at the University of Michigan. He went on to produce one of the classic research papers in this field, reporting the health benefits to hospital patients from having a room with a view of trees rather than a view of a brick wall (Ulrich, 1984). He showed that these patients spent less time in the hospital (7.96 vs. 8.70 d), used fewer doses of strong pain relievers, and received fewer negative comments from hospital staff on their charts.

Roger Ulrich also explored some psychological and physiological human responses to nature, especially in relation to stress reduction (Ulrich, 1979, 1986; Ulrich and Simons, 1986). In one study (Ulrich, 1981), subjects viewed slides of nature scenes with water and vegetation, slides of nature scenes with only vegetation, or slides of urban scenes without vegetation. When people viewed either category of nature scenes, they exhibited higher alpha brain wave amplitudes than when viewing urban scenes. Higher alpha brain wave amplitudes are associated

with lower levels of physiological arousal and higher levels of attentive relaxation, which is generally viewed as a positive state for people. The subjects also reported that the nature slides held their attention better than the urban slides, even though all of the slides were judged to have similar informational content.

Examples of recent research on psychological and physiological responses

If plants reduce stress as indicated by Ulrich's research (Ulrich and Simons, 1986), then we should see this response manifested in additional ways. More recent research has, indeed, built on and expanded these early examinations of the role of plants in stress reduction. Lohr et al. (1996), explored what aspects of nature evoke responses by testing subjects in a room with or without potted plants present, instead of using videotapes or slides of nature. Subjects concentrated on a computer task; the subjects' attention was not drawn to the presence or absence of plants. When plants were present, participants were less stressed and reported feeling more attentive than participants tested with no plants present. In the presence of plants, participants also had quicker reaction times on the computer task than in the absence of plants. This work showed that the mere presence of individual plants can evoke calming responses; focusing on complete scenes of nature is not required.

Another study has focused on the effects of views of nature on mental attention and fatigue. Tennesen and Cimprich (1995) tested college students in their own dormitory rooms. Some of the students were housed in rooms with window views that were dominated by nature, while others had views that were dominated by hardscape (buildings and sidewalks, for example). Students performed a series of tasks that required mental concentration, such as substituting numbers for a random set of symbols (symbol digit modalities test). Those in rooms with a view completely of nature performed significantly better on some of these tests than did students with views that were dominated by hardscape, thus indicating that students with nature views were better

able to focus their attention to the desired tasks.

A different manifestation of the potential calming influence of plants was reported in a recent study by Kuo and Sullivan (1996) that asked apartment complex residents about domestic violence. Respondents lived in public housing and could not choose their apartments. Some were assigned to live in complexes surrounded by trees, while others were assigned to buildings without green surroundings. When asked if they had engaged in violence during the past year, 22% of the women interviewed from the apartments without trees said "yes" while only 13% of the women in the apartments surrounded by trees said "yes". When asked if they had hit their children in the past year, 14% from the nongreen apartments said "yes", while only 3% living in apartments near trees said "yes".

Other U.S. researchers are continuing to pursue the impacts of plants on human health and well-being. Studies have demonstrated the effectiveness of participating in restorative activities in nature in helping women recover from breast cancer (Cimprich, 1993) and the self-administration of walks in natural areas to reduce perceived stress (Bennett and Swasey, 1996). Another study showed that older people living in housing units with common outdoor spaces planted with trees experienced more positive interactions with their neighbors than did those living in units with common outdoor spaces with paving (Kweon et al., 1998).

Research on plants on air quality

In addition to the early studies on landscape preferences funded by the U.S. Forest Service, other agencies of the U.S. government have played an important role in furthering research on other aspects of the impacts of plants on people. The National Aeronautics and Space Administration funded early studies on the use of plants in space stations. They were interested particularly in using plants to clean the air in these facilities. One early study showed that common interior plants were highly effective in removing formaldehyde from sealed chambers (Wolverton et al., 1984). Further work documented similar effects with additional pollutants, such

as carbon monoxide (Wolverton et al., 1985) and began to document the mechanisms involved (Wolverton et al., 1989). This work, which the Associated Landscape Contractors of America (Herndon, Va.) also began to fund, has been highly publicized in the interior landscaping trade (Nieman, 1992; Wolverton et al., 1990) and has even been presented in building trade journals (Healthy Buildings International, 1991), grocery trade communications (Craig, 1997), and public health magazines (McAuliffe, 1990). A popular paperback even recommends which plants to try for removing specific sources of pollution (Wolverton, 1997).

Other studies on the impacts of plants on air quality, and thus indirectly on human health, have followed. One researcher looked at the ability of interior plants to affect indoor relative humidity (Lohr, 1992a, 1992b). While it is well known that plants contribute relative humidity to the surrounding air through transpiration, before these studies it was not known whether the level was sufficient to impact air quality in buildings. Some people in the building trades feared that the use of interior plants would damage building materials from too much humidity. Plants in these studies did not contribute excessive humidity to interiors, but did raise the relative humidity from levels below the range recommended for human health to levels within the range.

The influence of interior plants on dust accumulation has also been explored (Lohr and Pearson-Mims, 1996). Other researchers have shown that plants can influence particulate matter deposition outdoors. This study showed that the same thing occurs on the smaller scale of typical interiors: adding plants to the periphery of a room reduced particulate matter deposition by as much as 20%. The plants in this study were in self-watering containers that prevented growing medium moisture from being exposed to the air; the growing medium surface was extremely dry and dusty. Documenting that interior plants are associated with reduced dust was especially important, because it allayed fears that the growing medium in containers might actually be making interiors dustier. The results of this study further documented the important relationship between plants and interior air quality.

Other researchers are expanding

our understanding of the use of plants to improve outdoor air quality as well. For example, one study examined the effects of tree cover on parking lot temperatures and used models to predict the effect this could have on motor vehicle emissions (Scott et al., 1999). The potential to reduce emissions, using conservative estimates, were modest, yet within the same range of other measures being considered to reduce pollution, such as scrapping older, polluting cars and light-duty trucks.

Research on implementation of horticulture for human well-being

Concurrent with the increase in basic research to understand the psychosocial, physiological, and physical roles of plants, there has been an increase in research into the application of horticulture in various human endeavors.

SCHOOL AND YOUTH GARDENING. There has been a national movement over the last 10 years, encouraged by the National Gardening Association (NGA, Burlington, Vt.), the American Horticultural Society (Alexandria, Va.), and numerous botanical gardens, to integrate gardening into school curricula. Studies are beginning to be conducted to determine the efficacy of specific resource materials and to understand what makes a school gardening program effective. Researchers at Texas A&M University (Campbell et al., 1997; Skelly and Zajicek, 1998; Waliczek and Zajicek, 1999) reported that participation in Project GREEN (Gardening Resources for Environmental Education Now) resulted in significantly improved environmental attitudes among children.

Using the World Wide Web site KinderGARDEN, Waliczek and Zajicek (1999) conducted two surveys with self-selected participants returning e-mail responses. Adults gardening with children reported benefits to children's self esteem and stress levels. Interestingly, parents viewed the food as important while teachers thought that socializing and learning about plants were important, and children valued the experience as recreation. Eighty one percent of the children felt that they learned about the environment while working in the garden.

In a survey of teachers who received NGA gardening grants, DeMarco et al. (1999) found that the most important factor in the successful integration of gardening into the school curriculum was ownership of the concepts and goals by the teachers and students. She also found that the teachers did not use the garden simply to teach gardening, plant science, or environmental attitudes: they also used it to teach language arts, art, and ethics. They reported that their goals when using school gardens were academic, social, recreational, and therapeutic.

To identify factors that would increase the use of gardening to meet the Virginia Standards of Learning (SOL) in the classroom, Dobbs et al. (1998) surveyed kindergarden to sixth grade teachers from schools across the state. The interest rate in introducing gardening to the classroom as a teaching tool was 88%. The greatest needs expressed by these teachers were teaching resources (i.e., lesson plans, newsletters, audiovisual materials), volunteer support (e.g., Master Gardeners), and additional training for teachers. The research by Dobbs et al. (1998) and DeMarco et al. (1999) has resulted in the development of a graduate-level special topics course, Integrating Horticulture into the Elementary School Curriculum, which is taught in cooperation with urban botanical gardens as a summer intensive course. In addition, the revision of gardening fact sheets to highlight how they can be used to meet the SOLs in all teaching areas and the provision of training for Master Gardeners working with classroom teachers and students have been implemented.

JUVENILE OFFENDERS are a unique subset of youth, and the application of gardening with these individuals often has goals that are different than in the classroom. The Green Brigade is a community based program started by the Bexar County Agriculture Extension Service (Finch, 1995). Based on a study of this program, Dawson and Zajicek (1999) reported an 8% increase in horticultural knowledge and a 7% improvement in environmental attitude scores. They also found that the Green Brigade program was as effective as traditional probationary programming at reducing the rate of and severity of crimes by juvenile offenders.

Findings reported by Flagler

(1995) regarding the Rutgers Careers in the Green Industry program indicated that an organized, vocationally based education program is an effective curriculum for this population. He reported that over 70% of the youth indicated they had increases in: contacts with people that could help them, ideas about future education, as well as experience and skills.

In a study conducted at an alternative education program for youth on probation, McGuinn (1999) noted that, among the small group she studied, there was strengthening in the delinquent individual's bond with society and the youth were motivated to think more practically about their future and career possibilities. Five of the six students in the study were interviewed and hired for various summer positions by public or private horticulture concerns after the course was completed. These findings further reinforce Flagler's conclusions that horticulture is an effective curriculum focus for vocational training of juveniles on probation and other youth at risk. Further studies are currently being conducted in a program for juvenile offenders in Norfolk, Virginia (Bradley, 1999; Eastman, 1999).

HORTICULTURAL THERAPY. A research-based body of knowledge is continuing to grow in the field of horticultural therapy as more researchers document both the benefits and the effective methods of horticultural therapy. There has been particular focus on work with the elderly in various levels of treatment or care.

Two separate studies (Kerrigan and Stevenson, 1997; Predny and Relf, 2000) of intergenerational programming using horticultural therapy in daycare facilities for adults reached similar conclusions, despite the fact that the age and abilities of the children and seniors were very different between the two studies. Both found that horticultural activities that focused on plant culture resulted in greater interaction than those activities that involved craft-type work. Another critical finding in both studies was that facilitators in the activity had the most impact on the degree of interaction taking place between the more capable of the clients.

For seniors in intermediate care, Mooney (1994), using three different psychological measuring tools, found a pattern of improvement after the treatment was implemented and de-

cline when the therapy was withdrawn to be a classic pattern for the experimental group. For elderly adults with cognitive impairment, such as Alzheimer disease, another study (Mooney and Nicell, 1992) indicated that a properly designed outdoor environment "reduced incidents of aggressive behavior and contributed significantly to a risk management program."

COOPERATIVE EXTENSION IMPACT-BASED PROGRAMMING. In recent years it has become clear that the goal of cooperative extension programs must be more than simply to provide answers. The goal must be to actually change the attitudes, knowledge, and behavior of clientele groups, whether the issues addressed are environmental, economic, or social. One of the first steps in accomplishing this is to understand the motivation for participation in a program. Particularly in urban extension programs, horticulturists are responsible for conducting the research regarding their clientele.

The first group to receive extensive study has been Master Gardeners (MGs) who are volunteers trained by extension to conduct educational programs. Rohs and Westerfield (1996) identified factors that influenced MGs' decisions to join the program. Stouse and Marr (1992) explored what factors influence retention of MGs. Relf and McDaniel (1994) assessed MGs' priorities for the program. Meyer and Hanchek (1997) compared MG training costs and payback in volunteer hours, and Schrock et al. (1999) looked at the perception of personal and societal benefits of the MG program to the MG. These types of data have been influential in the development of management tools to direct effective recruitment and utilization of MGs in a diversity of programs (Dorn et al., 2000).

RESEARCH ON HUMAN ISSUES IN HORTICULTURAL INDUSTRIES. All of the information gained in exploring human issues in horticulture will ultimately benefit the horticulture industry. Currently, the widest acceptance and acknowledgment of research on human use of plants among horticulture professionals is in the area of marketing and employee issues. Human issues in horticulture research conducted by horticulture faculty regarding horticulture products has been on widely varied topics. Examples include: the

use of focus groups to determine product market potential (Barton et al., 1996), surveys of consumer preferences regarding pesticide free pumpkins (Olson et al., 1995), and florists' actions regarding the recruitment of commercial accounts (Anderson et al., 1996).

Training for garden center employees is an important issue that was addressed by two surveys conducted by Musgrove et al. (1996). The first was to determine variables in the selection of location to purchase plants by MGs (as representatives of devoted gardeners) including availability of store employees to help them and confidence in the level of knowledge of store employees. The second survey looked at the job training received by the employees in retail garden centers. The data indicated that an effective training program could be one factor in attracting quality employees and maintaining customers. It could also play a role in the retention of employees.

These and other studies that focus on the human side of horticultural enterprises will be essential in the future as horticulture competes against an ever increasing multitude of options for the consumers of goods and services.

Current impacts of research

Studies such as these have increased the credibility of the field of human issues in horticulture in the eyes of economically motivated cultures. Businesses in the United States have begun to promote these newly documented impacts of plants on people. Data are being used to promote the green industries both by individual companies in the United States and by industry trade groups (e.g., Plants for Clean Air Council, 1999). Training sessions for members of the industry have been sponsored by Southern Nurseryman's Association (Atlanta, Ga.) in conjunction with American Nursery and Landscape Association (Washington, D.C.) and talks have been presented at the Ornamentals Northwest Seminars (Portland, Ore.).

Businesses outside of the green industries are also beginning to apply this work. Plants are being added to interior spaces to improve air quality. Businesses are adding restorative views

for their workers. Hospitals are incorporating healing and therapeutic gardens (e.g., Center for Health Design, Lafayette, Calif.; Griffin Health Services Corporation, Derby, Conn.). Horticultural therapy is growing throughout the world. Specialists from the United States have visited other countries as consultants to help nurture new programs.

Keeping up with the changes in this field can be difficult, because work related to human issues in horticulture can appear in many places and in various forms. The researchers, teachers, practitioners, and businesses that focus on the impacts of plants on people are scattered through different disciplines and locations. It is critical for those of us who are involved in this field to reach out to each other to keep in touch, expanding the network that brings knowledge together. As a result of an expression of this need at the 1990 symposium on "The Role of Horticulture in Human Well-being and Social Development," the People-Plant Council was formed (Lewis, 1996). The Council serves as a clearinghouse for information, as well as a center point for people interested in the interaction between plants and people to contact with each other. The Council publishes a newsletter spreading news on activities in human issues in horticulture and encouraging others to share the knowledge as widely as possible. The Council coordinates symposia and meetings on human issues in horticulture and distributes databases of related publications. For information, contact Diane Relf, The People-Plant Council, Department of Horticulture, Virginia Tech, Blacksburg, VA 24061-0327.

Conclusions

The expanding knowledge base in the field of human issues in horticulture has been paralleled by related studies in other environmentally related fields. In his book *Biophilia*, E.O. Wilson, a prominent biologist in the United States, has promoted the idea that people are profoundly connected to nature, and are, in fact, innately nature-loving (Wilson, 1984). While there is controversy surrounding his idea, primarily from traditional scientists who say he doesn't have enough research basis for his notions, he is confident that he and others like him are on to something (see Kellert and

Wilson, 1993). He developed his ideas the way that people throughout the ages have developed ideas, the way that the Native Americans who look disparagingly on our scientific method have developed ideas, by quietly living with, listening to, and learning from nature. He began his work by studying ants, and eventually saw that what he was learning spoke about humans, as well. In fact others who profess such an awareness also began by studying other organisms: for Hugh Iltis it was corn, while for Gordon Orians it was birds.

Most of us who work with plants are doing so because we too are aware of that connection between plants and people, just as E.O. Wilson is. We must each do our part to promote this important field that across the Americas, across the world, and though the ages, has critically contributed to the health and well-being of the world and will become increasingly important as our world faces the challenges of the future.

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