DEPARTMENT OF HORTICULTURAL SCIENCES
ANNUAL IMPACT REPORT
April 15, 2008

AgriLIFE RESEARCH
Texas A&M System

AgriLIFE EXTENSION
Texas A&M System

College of Agriculture and Life Sciences

TEXAS A&M UNIVERSITY

DEPARTMENT OF HORTICULTURAL SCIENCES ANNUAL IMPACT REPORT
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EXECUTIVE SUMMARY

Through a diverse group of faculty and staff members, the Department of Horticultural Sciences engages in programmatic activities that have educational, scientific, economic, environmental, and social impacts. These are summarized in this section. More detailed information can be found under the sections for individual faculty members (pages 5-20).

Educational Impacts

Our new BA degree program, the only one of its kind in the U.S., is offering our undergraduates new educational opportunities that better prepare them academically for service to the green industry. Since the new degree program was instituted, we have seen a 28% increase in students taking landscape-related courses. In support of this program, new courses related to urban ecology have been developed and offered. To further broaden our students' horizons, a course on the Science of Foods for Health is also being developed.

With the cost of education being a concern for many students, we are pleased to offer a variety of scholarships which help lighten their economic burden. Last year we awarded 48 scholarships with a total value of just over $50,000.

We support the educational mission of the University by offering 3 courses that satisfy requirements for the University Core Curriculum: HORT 201/202 (Horticultural Science and Practices) counts toward the Natural Sciences requirement; HORT 203 (Floral Design) counts toward the Visual and Performing Arts requirement; and HORT 335 (Sociohorticulture) counts toward the Social and Behavioral Science requirement. In addition, we offer courses that satisfy University requirements for International and Cultural Diversity (HORT 335, Sociohorticulture) and for Writing Intensive courses (HORT 225, Horticulture Learning Community; HORT 315, Component Analysis of Horticultural Systems; HORT 418, Nut Culture; HORT 435, Urban Horticulture).

Our graduate program provides advanced training and mentoring to students. Several of our recent graduates have been hired in faculty positions at peer institutions. We also have trained young scientists who are now in the plant breeding industry.

Through our extension programs, we provide many outreach education opportunities. Through 115 County Master Gardener programs, 1,075 individuals were trained to become Texas Master Gardener Interns. In 2006, the corps of Texas Master Gardeners and Interns totaled 5,038. They provided 395,422 hours of volunteer time to Extension educational projects. The Junior Master Gardener program, which was started in our Department, enrolls more than 250,000 children in about 300 registered programs in Texas. This program engages children in "hands on" learning experiences that promote an appreciation for gardening and the environment, and trains over 500 public school teachers and 275 volunteers each year. Our Earth Kind program provides training to maximize gardening and landscape enjoyment while preserving and protecting our environment. The overall objective of Earth Kind is to combine the best of organic and traditional gardening and landscaping principles to create a horticultural system based on real world effectiveness and environmental responsibility. The TAMU Horticultural Gardens not only provide an excellent educational resource for the community, but also provide a "living laboratory" for our students.

During 2007, our Aggie Horticulture web site served 214,919,677 files to 14,834,926 user sessions representing 57,999,460 pages of educational information. Of the 55 web servers reporting to the Texas AgriLife Extension Service web site statistics data base, Aggie Horticulture serves 64.4% of the total pages and 44.6% of the total unique hosts. According to the Alexa Traffic Rankings, Aggie Horticulture is the second most active web site in the tamu.edu domain.

Scientific Impacts

Through our research programs, faculty members have made significant contributions to plant science. Examples include: identification of molecular markers to better understand the ability of plants to withstand adverse environmental conditions; an improved understanding of the carotenoid pathway in watermelons (carotenoids have human health implications); improved knowledge of bioactive compounds in citrus which have human-health promoting properties; improved understanding of the molecular aspects of plant tolerance to salinity; characterization of physiological differences between pecan genotypes which have ramifications for production and management practices; improved understanding of how plants respond to low pressure atmospheric pressure which has significant implications for crop production in outer space.

During the past year, such scientific impacts have been documented in a total of 50 refereed journal article publications and through a large number of presentations made at scientific meetings (see Metrics section, p. 21). Through our Vegetable and Fruit Improvement Center, we also hosted a major scientific symposium that facilitated scientific exchange regarding the human health benefits of fruits and vegetables and which attracted a total of nearly 300 participants representing 38 countries.

Economic Impacts

A variety of our programs are having economic impacts in industry. Virtually all of the russet potatoes grown in Texas in 2007 were to the improved Texas Russet Norkotah strains from our Department. Average summer potato yield in Texas has increased to nearly 440 Cwt/A (compared to 200 Cwt/A in 1973) thanks in large part to the cultivars released from our potato breeding program. Also, Texas ranks number 1 among the 12 states with summer potato production with an estimated economic impact of over $150,000 million.

The development of low-chill peaches will open up economic opportunities to grow this crop in southern regions of the country. The development of new peach flesh colors, flavors, and nutritional content will help improve the profitability of peach production in southern regions. Also, low-chill cultivars are providing an economic opportunity to grow peaches instead of the poppy used for illegal drug trade in Thailand.

Because a large amount of potential crop yield is estimated to be lost due to environmental stresses, studies of gene expression related to stress tolerance have economic implications. The outcomes of this work are helping to design more effective biotechnology strategies aimed at ultimately reducing yield loss due to environmental stress.

Pecan growers have begun adopting recommendations derived from our pecan research which have economic implications. For example, growers now understand that summer hedging of trees is not worthwhile and that winter hedging is worthwhile only if applied on a yearly or biennial basis. Research on the nutritional properties of pecans is helping increase the value, marketability, and profitability of pecan production.

Floricultural research is facilitating the selection of high-value, high-demand crops for cost-effective greenhouse production of high-quality, long-lasting products. Specific recommendations are being formulated for Dendrobium orchids and container gardens. Research on landscape plants is facilitating sustainable crop production and efficient establishment of landscape plantings. This work has been highlighted in a major regional periodical and a national magazine.

The nearly 400,000 hours of service provided by Master Gardener volunteers provides a significant economic impact. This service, equivalent to 195 full-time employees, increases the human capacity of Extension by 15 percent. The economic value of this service translates to a $7.2 million benefit to the State of Texas.

Environmental Impacts

Research on sustainable horticultural systems is helping to reduce the requirements for water, fertilizer, and other inputs for field, nursery, and greenhouse crop production. Ecosystem research is helping to better manage the southern oak-savanna. Similar research is helping to better understand how negative environmental impacts of urbanization can be managed and reduced.

Throughout our courses, students are being taught about the importance of the environment and the need for sustainable management practices. Our Earth Kind program focuses on how homeowners can preserve and protect our valuable natural resources through the use of "environmentally friendly" practices. In the Holistic Teaching Garden, emphasis is on the garden as an ecosystem and its relationship to the larger, natural ecosystem.

Social Impacts

Sociohorticulture research efforts have documented the benefits of gardening and green spaces for children, college students and the elderly. We also have a variety of courses that teach our students about these benefits. The Holistic Teaching Garden introduces students and all who visit it to the restorative value of nature, to the garden as a place and a process which help reduce physical and mental stress and fatigue. Research on bioactive compounds in fruits and vegetables has significant human health implications.

IMPACT STATEMENTS FROM INDIVIDUAL RESEARCH/TEACHING FACULTY

Dr. Michael Arnold, Professor

My teaching efforts directly impacted over 200 undergraduate or graduate students through direct classroom and laboratory instruction. These efforts were further validated by my receipt of the Association of Former Students of Texas A&M University's 2007 College Level Distinguished Achievement Award for Teaching. Mentoring of graduate students resulted in the graduation of two Ph.D. students during the year, both of which have been hired in faculty positions as Assistant Professor by peer our institutions. I also contributed to the Department through service for approximately half of the year as the Associate Head for Research and Graduate Studies.

In the research arena a total of nearly $45,000 of funding was generated from a combination of competitive grants, contracts, and royalty from intellectual property to support a highly productive program in sustainable nursery crop production and efficient establishment of landscape plantings. Seven peer reviewed refereed journal articles, two editor reviewed conference symposia proceedings, and several presentations at international and national scientific meetings were produced. Five popular press articles helped to translate this work's relevance to the general public. Our research or outreach efforts were highlighted in articles by other authors in both a major regional periodical and a national magazine.

Dr. Marla Binzel, Associate Professor

The development of salt tolerant crops and landscape plants (including turf) is becoming increasingly important in Texas. Dwindling water resources are forcing the use of reclaimed water and water of margin quality for irrigation, reserving the higher quality water for municipal demands. There is considerable natural variation amongst different turf grasses with respect to their salt and drought tolerance. Combining traits such as salinity and/or drought tolerance with other breeding objectives (such as insect or disease resistance) is hindered by the lack of facile, reliable screens for these traits. Ultimately, the identification of molecular markers associated with salinity and drought tolerance would greatly enhance the ability of breeders to develop varieties of turf which could survive both reduced irrigation, and the use of irrigation water with higher levels of salt. Before markers which are associated with salinity tolerance can be identified, there existed the need for the development of a salt-screening protocol that is 1) highly reproducible, 2) amenable to high throughput, and 3) cost effective.

We have developed a system which is amenable to screening large breeding populations (on the order of hundreds of lines) in a relatively small footprint in the greenhouse. Data indicate that the response of lines is quite reproducible within a given experiment, and preliminary data further suggest that scoring of lines is consistent across seasons. In addition, we are evaluating parameters such as ion contents, which might eliminate the need to rely on subjective evaluations, such as visual scoring. Utilization of this system will assist breeders in the evaluation of elite germplasm, and accelerate the delivery of new turf varieties which could be used in a sustainable management plan to reduce landscape water consumption while still providing the benefits (aesthetic and environmental) afforded by maintaining turf in home landscapes and parks.

Dr. Dave Byrne, Professor

Stone Fruit Breeding and Genetics Program

The development of medium and low chill *Prunus* varieties will open up the southern regions of the country for peach production advancing the commercial harvest by 2-3 weeks. This advances the harvest in two ways: shortening the fruit development time and lowering the chilling requirement to allow earlier bloom and excellent production in the more southern zones. Work with partners throughout the world extends this concept and potentially will increase stone fruit consumption. Work in Thailand focuses on the development of low chill peach as an alternate high value crop to poppy. Additionally work progresses to develop new types of peach products (flesh colors, flavors, nutritional content) adapted to these low chill zones to create a more profitable production paradigm.

Fruits have been touted as very healthy foods and the present work on stone fruit is concentrating on the clarification of the effect of stone fruit phytochemicals has on cancer proliferation and its anti oxidant activity. This will help the consumer decide what foods to eat to maintain their health.

Rose Breeding and Genetics Program

Disease resistant rose varieties are expanding the market for roses as a landscape plant and reduce the amount of pest and disease control chemicals needed to maintain the plants' health. This work is complemented by mapping and genomics studies which will lead to a better understanding of the rose genome and better methods to create disease resistant varieties.

Teaching in Fruit Culture, Tropical Horticulture and Genetics

I firmly believe that the best way to impact a student's understanding of their world is to experience the subject and get them to "see" things in as many ways as possible. In my courses, I have guided projects in which I give my input during various stages of the project. In this way, I feel I am able to encourage the students to develop their reasoning and communication skills: both essential skills they will need to become the leaders of their communities and their industry.

Dr. Luis Cisneros, Associate Professor

Our program has two research lines which we consider can benefit Texas. On one side, we study the use of appropriate postharvest technologies that can keep the quality and extend the shelf-life of different types of products while enhancing the health-related properties of fruits and vegetables. For this purpose we use abiotic stresses to design appropriate technologies.

Another research line includes the area of bioactives. We focus on bioactive compound discovery from different plant sources including fruits, grains, vegetables and herbs using an array of assays screening for specific health issues related to cancer, cardio, obesity, and antioxidants, among others. We screen plants, identify compounds, study extraction methods and stability properties.

This information would benefit Texas because we can design postharvest strategies to provide high quality and healthier products to consumers. On the other hand our bioactive compound discovery work has the potential to provide value-added to a diverse range of crops and the possibility to reach markets and processors such as the food industry, dietary supplements, cosmetics, pharmaceutical and agrochemical.

Dr. B. Gregory Cobb, Associate Professor

This year's research was aimed at understanding structural changes that are associated with PD in Texas grapes. We found that there are 3 different types of infections that occur in grapes. In addition we have found evidence of programmed cell death in grapes infected with PD and that the symptoms of PD can be mimicked by adding ethylene to non-infected grapes. This is important in that it may point to possible methods that can be used to treat PD.

Dr. Fred Davies, Professor

Fred Davies' research program has focused on three areas: 1) utilization of beneficial mycorrhizal fungi as biofertilizers, and for enhancing drought and nutrient stress resistance of ornamental plants, 2) NASA-funded low atmospheric pressure, controlled environment crop systems, and 3) assessing the influence of fertilization on insect herbivore population dynamics and crop quality using chrysanthemum and gerbera as model crops.

His research group (Dr. Chuanjiu He, Jay Spiers) in collaboration with Drs. Kevin Heinz, Amanda Chau, Carlos Bogran and Scott Ludwig in Entomology have been funded for the past five years on a USDA-Floriculture and Nursery Research on "Floriculture and Nursery Crop Production with Reduced Cultural and Pest Management Inputs." To date they have reported that aphids exposed to high fertility regimes depress plant vegetative and reproductive growth, decrease plant photosynthesis and increase ethylene production in reproductive buds and young leaves, thus influencing plant quality and salability. Their results also show that commercially used fertility levels will increase western flower thrips population sizes, which decrease photosynthesis and stomatal conductance and reduces plant quality. A long-term goal of this research is to fine-tune and reduce fertility and pesticide usage in controlling insect pest population levels and enhancing plant quality. A graduate student, Jay Spiers, is studying the effects of nitrogen fertility on the host plant resistance of gerbera to western flower thrips. He is looking at systemic acquired resistance responses of how gerberas respond to thrips and the natural chemicals gerberas produce in the resistance process — such as jasmonic, salicylic acid and phenolics.

There will not be a human presence in Lunar or Martian habitation without Horticulture. Davies, Dr. Chuanjiu He and Dr. Ron Lacey (Biological and Agricultural Engineering) have been collaborating on NASA-funded research ($808,102) since 2001. There are engineering, safety, and cost advantages in growing plants under low pressure conditions. In addition they report that plants do better under low pressure (25 kPa) than earth ambient pressure (101 kPa), in part because low pressure depresses the phytohormone ethylene (which can cause senescence and irregular plant growth), plus dark respiration (at night) slows down, which leads to greater biomass production. This research also has application to controlled crop production systems, sustainable, reduced input production systems and controlled atmospheric (CA) storage systems of horticultural crops. Their research was reported in a 2007 British Broadcasting Corp (BBC)-Science in Action Report and one of their papers made the Oct 2007 cover of *Physiologia Plantarum*, one of the leading plant biology journals. A Visiting Professor, Dr. Nihal Rajapaske, on sabbatical leave from Clemson University conducted research in 2007 in Davies' Lab on "Effect of oxygen concentration in the growing environment on phytochemical composition and functional quality of lettuce plants", in collaboration with Drs. Luis Cisneros, Ron Lacey and Chuanjiu He.

Further information and pdf files of publications from Davies' research group can be found at http://aggie-horticulture.tamu.edu/faculty/davies/index.html

Dr. Steve King, Associate Professor

The primary goal of the watermelon breeding program at Texas A&M University is to train young scientists in the field of plant breeding. This goal is achieved by developing a world-class breeding program focused on developing innovative genetics to deliver to the growers of Texas and the world through seed companies that support the research efforts at the Vegetable & Fruit Improvement Center and the Department of Horticultural Sciences. The program strives to strike a balance between basic research in the lab, more applied research in the field, and continuous

consulting with growers, other researchers and the industry. An effective balance will ensure that any discoveries made in the lab will have an application in the field and be of benefit to the growers and industry whom we support. We will strive to stay abreast of the whole vegetable industry in Texas and adapt to changes as they occur.

So far we have delivered a better understanding of the carotenoid pathway in watermelon and have developed a molecular marker to distinguish between red and canary yellow flesh watermelon. We believe this marker is actually attached to the key gene in the carotenoid pathway that causes watermelon to accumulate lycopene, or other downsream carotenoids. A collaborator in Israel is currently cloning our gene into an E. coli system to prove that we have discovered this critical gene.

We have also discovered a single recessive mutation that causes multiple diverse phenotypic changes in the structure and development of watermelon plants. Plants carrying the homozygous recessive mutation exhibit etiolated seedlings, less lobing of the leaves, longer internodes, faciated stems and is male sterile due a lack of dehiscing of the anthers. While this mutation probably has no commercial value, it should be valuable material to study genetic regulatory mechanisms in watermelon.

We have established a watermelon grafting protocol in our lab and now have the ability to graft watermelon and other vegetable crops to study grafting effects on disease resistance, cold tolerance, yield and quality. We have discovered a rootstock that improves the cold tolerance of watermelon where grafted seedlings can survive 48 hours at 5oC, while non grafted controls will wilt and die. We have also grafted watermelon onto transgenic virus resistant squash and asked the question: since the squash is deregulated, will the watermelon grafted onto these plants also be deregulated? The current opinion from the USDA BRS is that yes, the watermelon plants will not be regulated; however, we still need to challenge this opinion by filing for an environmental release.

We have eight new tetraploid breeding lines that will be crossed with diploids to evaluate the performance of new seedless watermelon varieties. We are in the process of determining the bioaccessibility of carotenoids from multiple whole food sources, with the goal of comparing watermelon to tomato and other carotenoid containing foods. We hope to establish not just which foods contain the highest levels of these health promoting compounds, but also which foods can deliver the maximum levels.

Another ongoing project is to examine factors that affect the livelihood of small scale commercial vegetable producers in Texas. We are examining market outlets and value added approaches that will allow these small scale producers to make a living from their efforts.

Dr. Patricia Klein, Associate Professor

Overall goals of our research program are 1) to understand the genetic basis of plant adaptation to adverse drought prone environments; 2) to identify and characterize genes and regulatory

networks that contribute to adaptation; 3) to identify, map and utilize beneficial alleles for traits that contribute to improved plant productivity in adverse environments; and 4) to work in collaboration with a team of scientists at TAMU to develop high biomass, widely adapted sorghum lines for the emerging bioenergy/biofuels market. Our research program is funded through grants from the National Science Foundation, the Department of Energy and private industry.

World population is now over 6 billion and is projected to increase to ~10-11 billion before peaking between 2025-2050. Crop productivity needs to increase significantly on agricultural land to meet the needs of a larger and rapidly developing world population for food, feed, biofuels and bioproducts while at the same time preserving land for wildlife habitats. Current crop yield is limited to a large extent by abiotic constraints, especially water deficit. Limited new water supplies for irrigation and increasing demand for water for non agricultural uses means that the yield of crops grown in environments subject to periodic drought will need to increase primarily through genetic improvement. Drought tolerance will be especially critical for bioenergy crops such as sorghum, switchgrass and *Miscanthus* that ideally will be grown on more marginal lands to reduce competition between food and fuel crops. Grain sorghum is currently grown on ~63 M ha ranking 5th in overall production among cereal crops. Sorghum is also grown as a forage crop on millions of hectares and bioenergy sorghum is likely to be grown widely in the future. Sorghum is one of the most important grain crops for the semi-arid tropics, especially for subsistence farmers in Africa, and its importance as a source of food, feed and biofuels is likely to increase if global warming trends continue.

Sorghum bicolor, the main source of commercial sorghum cultivars, is an excellent system for genome research on C4 grass species because it has a small genome relative to most other grass species (810Mbp; 10 chromosomes), good genetics (diploid, inbred), a large and diverse germplasm collection (~40,000 accessions), and a well developed genome technology platform. Most of our initial work in sorghum focused on the development of this genome technology platform for use in downstream map-based cloning projects. Our first objectives were to construct a genetic map of sorghum that was linked to a BAC-based physical map. We generated the first high-density genetic map of sorghum containing more than 3000 markers consisting of AFLPs, SSRs and universal grass probes. In addition, we constructed a BAC-based physical map using high information content fingerprinting and integrated the physical and genetic maps using a novel 6-dimensional pooling technique combined with AFLP technology. The physical and genetic maps are linked at more than 1500 sites throughout the sorghum genome. We have also developed a molecular karyotype of the 10 sorghum chromosomes and used FISH-based karyotyping in concert with analysis of chromosome lengths, arm lengths and arm ratios to establish a size-based nomenclature for sorghum chromosomes that was adopted for use by the sorghum community. More recently a detailed cytogenetic analysis of sorghum genome architecture using BAC-based FISH was completed along with comparative analysis to rice. As part of an NSF-funded project in collaboration with scientists at the University of Georgia we helped to produce sorghum ESTs from 14 different cDNA libraries and developed cDNA microarrays containing ~22,000 uniscripts. Using these sorghum microarrays and qRT-PCR, we identified sorghum genes that are modulated in response to biotic and osmotic stress responses and performed phylogenetic and expression analysis of a family of ABA responsive genes to identify differences in *cis*-element modules associated with variation in gene expression.

We have used the genomics tools and resources developed through our program to map-base clone genes of agronomic importance including the major sorghum fertility restoration gene as well as a gene conferring aluminum tolerance. Additionally, we are collaborating with groups throughout the world to map-base clone genes involved in flowering time, insect resistance and

drought tolerance (stay-green). The technology and information generated by our project has been disseminated through publications, presentations at meetings, collaboration with groups hosting national relational databases, and through development of our website (http://sorgblast3.tamu.edu). The information and technology generated by our research is also being used to facilitate the efforts of other research groups to map and eventually clone additional important sorghum genes.

Dr. Hisashi Koiwa, Assistant Professor

Our research focuses on the mechanisms that connect basic biology of plants and salt/osmotic stress tolerance of plants. It has been estimated that up to 70% of annual crop yield is lost because of various abiotic stresses. Transcription of stress tolerance determinant genes is a key process for mounting acquired tolerance. Unexpectedly, the process that regulates general transcription is a pivotal regulatory mechanism of expression of such detrimental genes. The outcome of our research will help design more effective biotechnology strategies that involve gene expression. One of such efforts is initiated to design molecular switch to amplify gene expression during osmotic stress using a combination of a stress-inducible promoter, transcription factors and a mutant that is altered for general transcription machinery.

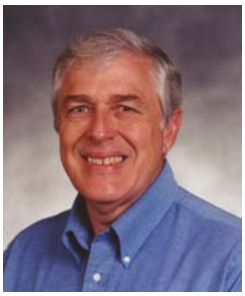
Another unexpected regulation of plant salt/ostmotic stress response operates at post-translational N-glycosylation of proteins. Complex N-glycans that are synthesized in the Golgi determine salt/osmotic stress tolerance of root growth. Our research on the function of complex N-glycans will help understanding how plants establish their root system in water-limited environment, and how N-glycans determine plant-pest interaction at the cell surface.

Casey L. Krueger, Lecturer

The Landscape Industry has seen a dramatic increase in the past three years. The Horticulture Department has seen an increase in demand for qualified individuals to fill these positions in the landscape industry. With this growing demand, there has been a 28 percent increase in the number of students partaking in the landscape horticulture classes.

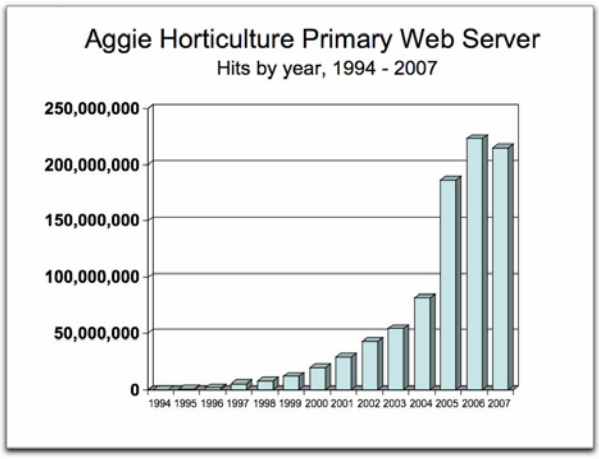
The Department has increased the number of classes in this growing interest area and is constantly revising teaching methods and techniques taught each year to match that of the industry. Through participation with industry professionals the Horticulture Department is reshaping the curriculum to better prepare students for the landscape industry job market. Several classes have been added to the curriculum to better prepare students for these trends. These efforts are essential to the department in the development of the new Bachelor of Arts degree program.

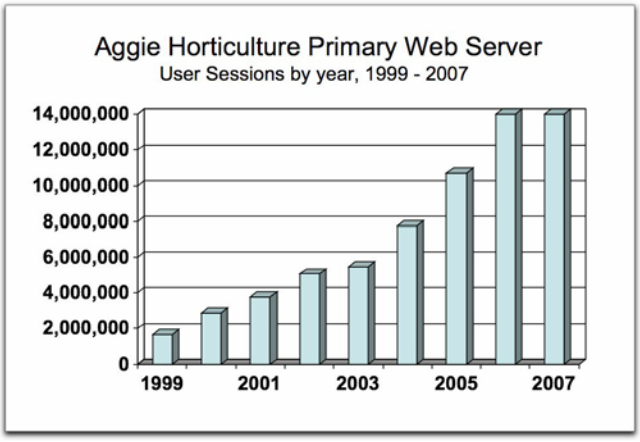
Dr. R. Daniel Lineberger, Professor



The Aggie Horticulture Web Network was launched officially in October, 1994. According to the 2007 Netcraft Web Server Survey, that places our server among the early entries. In August, 1995 Netcraft found 18,957 servers on the Web. The number of Web servers has grown to nearly 143 million in October, 2007[1]. According to a recent search of the Netcraft Web server ranking, Aggie Horticulture is ranked 41,141st in the world[2]. For comparative purposes, the Ohio State University horticulture site is ranked 305,889, N. C. State is 217,691, Univ. of Florida Environmental Hort is 233,487, and Cornell Horticulture is 292,614.

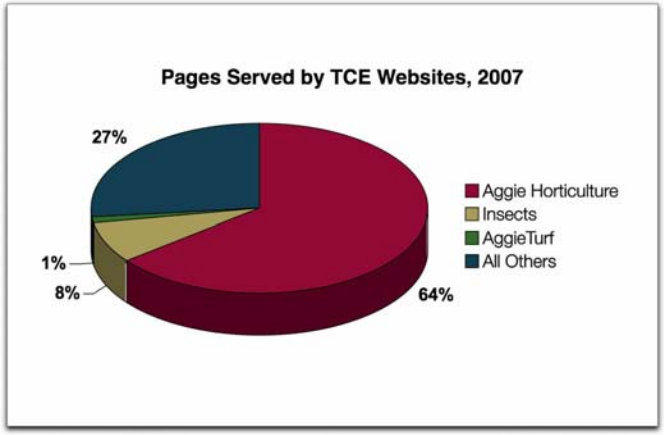
During calendar year, 2007, our main Web server served 214,919,677 files to 14,834,962 user sessions representing 57,999,460 pages of information.





Our high monthly total to date was in April, 2007 when we recorded over 29 million hits with nearly 1.6 million user sessions. To put this into some economic terms, *if* we mailed out that amount of information by US mail as we did prior to Aggie Horticulture, our Web presence would have saved us over $3.9 million dollars in postage in 2007 alone! ((57,999,460 pages/6 pages per article)*$0.41 postage = $3,963,296).

This year is the first year in which the hits and user sessions on Aggie Horticulture have not increased. We are adding little new information to our servers, and the competition from commercial Web servers that offer horticultural information has increased considerably. Much of



our effort has been toward building dynamic, database enabled tools and the overall database activity is not recorded in our user sessions.

Of the 55 Web servers reporting to the Texas Cooperative Extension Web Site Statistics database (which collectively serve 131 named Web sites), Aggie Horticulture serves 64.4% of the total pages and 44.6% of the total unique hosts[3].

According to the Alexa Traffic Rankings[4], Aggie Horticulture is the second most active Web site in the tamu.edu domain. If the traffic of PLANTanswers.tamu.edu (a virtual domain on the main Aggie Horticulture server) is considered (aggie-horticulture.tamu.edu (5%) + plantanswers.tamu.edu (1%) = 6%), then we will likely overtake the main Web site in April (our busiest month). Other sites of interest include:

www.tamu.edu	7%
aggie-horticulture.tamu.edu	5%
admissions.tamu.edu	2%
plantanswers.tamu.edu	1%
insects.tamu.edu	1%
plantpathology.tamu.edu	1%
elearning.tamu.edu	1%

Support for county Extension programs is one our major focus areas. This emphasis area is a collaborative effort of several TCE faculty, led by Don Wilkerson. The banner program for this group is the EARTH-KIND Web site, a comprehensive site that includes program planning materials for county agents as well as a public interface. The public interface includes streaming video and podcasts. Major additions to the EARTH-KIND educational materials during this reporting period include the Urban Landscape Guide. The ULG Web site logged over 110,000 user sessions between June and December, 2007. Another feature added to the EARTH-KIND Web site is the EARTH-KIND Challenge, a database-driven "quiz" designed to help consumers evaluate their gardening practices in contrast to the EARTH-KIND principles. The EARTH-KIND Challenge was taken 386 times between September 5 and December 30, 2007. The EARTH-KIND Online Master Gardener training modules were revised, including reformatting the presentations as streaming Windows Media files and revision of the tests, the evaluation survey, and county agent administration interface. Between January and December, 2007 418 online quizzes were taken by Master Gardeners, and since its inception in July, 2005, over 1077 certificates have been awarded to Master Gardeners through this program.

[1]Netcraft Web Server Survey. 2007. http://news.netcraft.com/archives/web_server_survey.html Accessed 12 November 2007.
[2]Netcraft Web Server Ranking. 2007. http://toolbar.netcraft.com/site_report?url=http://aggie-horticulture.tamu.edu Accessed 12 November 2007. Ranked in order of visits by users with the Netcraft Toolbar installed.
[3]TCE Web Stat Reports. 2007. http://tcewebstats.tamu.edu/reports.cfm Accessed 2 January 2008.
[4]Alexa Traffic Rankings. http://www.alexa.com/data/details/traffic_details/http://aggie-horticulture.tamu.edu/ Accessed 12 November 2007. Alexa ranks are computed by comparing the number of visits by users with the Alexa Toolbar installed. Ranks are computed only for top level domains (ie, tamu.edu; the 3 month average rank of tamu.edu is 5,174) but a percentage of traffic beneath the top level domain is also presented

Dr. Leo Lombardini, Assistant Professor

Issues

Pecan is the most valuable nut tree that is native to North America and has been grown for centuries for its edible nuts and timber. Today, pecans have an annual value worth about $60 million in Texas alone and about $300 million for the entire country. Despite these impressive statistics, pecan is a 'young' crop which has been cultivated for only approximately one and a half century. Many aspects of pecan growth, development, cultivation, post-harvest handling, and health attributes are only partially known and understood.

Cultivation
Tree crowding is a phenomenon that pecan growers have to face during their production cycle. Crowding induces reduction in number of flowers, productivity, percent kernel and it has been indicated as one of the possible causes for increase in alternate bearing.

Genetic diversity
Pecan is a species widely distributed over a vast area of geographic and climatic variation. Consequently, it has developed anatomical and morphological differences within the provenances.

Health properties
Nuts and small fruits have received particular attention because of their high content in phytochemicals. Pecans and other nuts are particularly rich in phytonutrients, such as monounsaturated fatty acids, vitamins, phenolics, minerals, and fibers. However, little is known about how to optimize the health benefits of pecans.

Actions

Cultivation
Trials were established in commercial orchards in different regions of Texas to investigate different approaches to minimize the negative effects caused on yield by tree crowding. Trials focused on timing, intensity and frequency of hedging. Additional trials focus on regulating pollination and fruit set.

Genetic diversity
Studies have been conducted to investigate the physiological (gas exchange, responses to light, etc.) and morphological (stomatal and trichome density, etc.) differences among selected provenances and genotypes.

Health properties
Pecan kernels from six cultivars were analyzed for their antioxidant capacity, total phenolic content, condensed tannin content, phenolic profile and fatty acid composition. Significant differences were frequently detected among cultivars.

Impacts

Cultivation

A few growers have started adopting the recommendations which derived from our investigations. For example, we have proved that summer hedging should not be applied and that winter hedging is worthwhile only if applied on a yearly or biennial basis.

Genetic diversity

Results from our studies will be very important for breeding and horticultural programs aimed at developing and choosing genotypes more adapted to specific environmental conditions, in order to reduce the amount of inputs necessary to produce this crop.

Health properties

The research we are conducting on the nutritional properties of pecans is significant because it is expected to increase the value, marketability and profitability of pecans. Organizations of pecan producers (Texas Pecan Growers Association, Texas Pecan Board, and Salopek Foundation) and distributors (National Pecan Shellers Association) are very interested in our research. Their interest has resulted in invitations to present results at their annual conferences and in providing additional funding to continue the research.

Dr. J. Creighton Miller, Professor

Twelve improved varieties have been developed/co-developed and/or released from the Texas Potato Breeding and Variety Development Program. Virtually all of the russet potatoes grown in Texas in 2007 were to the improved Texas Russet Norkotah strains. When this program was initiated in 1973, the average yield of the summer crop in Texas was about 200 Cwt/A. In 2005 the average summer crop yield in Texas was reported to be 440 Cwt/A, the highest in the nation among 12 states with summer crop production. In addition, the farm gate value of the crop has grown from less than $20 million to about $70 million with an annual economic impact to the state estimated to exceed $150 million. Of all varieties released over the past 15 years by the 12 potato breeding programs in the U.S., those developed by the Texas program rank second nationally in total acreage approved for seed certification in 2006. This is especially significant, since the state does not have a potato seed industry to promote Texas varieties.

Dr. Joe Novak, Senior Lecturer

Hort 301 - Garden Science and Hort 335 - Sociohorticulture have been adapted to become significant courses in the new Bachelor of Arts degree program in the Department and both courses attract a significant number of non-majors, some of whom transfer to become majors in our department.

Development of the Holistic Teaching Garden has had a significant impact on the programs in the Horticulture Department. The Holistic Teaching Garden introduces students and all who visit it to the restorative value of nature, to the garden as a place and a process which help reduce physical and mental stress and fatigue. In the Holistic Teaching Garden emphasis is on the garden as an ecosystem and its relationship to the larger, natural ecosystem. The Holistic Teaching Garden is accessible to all, regardless of physical abilities. The Holistic Teaching Garden is a working model for others to observe and to adopt ideas that they believe are appropriate for their institutional or private gardens.

Dr. Bhimu Patil, VFIC Director & Associate Professor

The Vegetable and Fruit Improvement Center (VFIC) research and educational activities have impacted clients around the country and world. Due to the expansion of our work, recently processing and packing industry members joined the Center. Our research activities related to biological activities of citrus and their bioactive compounds led to better understand the role of citrus in preventing neuroblastoma (child cancer) and colon cancer using cell and animal models. These results needs to be further confirmed using clinical trials. My research led to 9 peer-reviewed publications, 3 editor reviewed proceedings, 31 abstracts. Citrus class provided an opportunity to Texas A&M University-Kingsville students in addition to TAMU students. Patil's graduate students have excelled, which is evidenced by their outstanding record of refereed publications, national and regional awards/honors, and professional presentations.

As part of implementation of USDA-challenge grant on education, a two-day a workshop on curriculum development was hosted by Patil. The workshop was attended by the faculty from four land grant universities (Iowa State, Ohio State, University of Illinois, TAMU) of different disciplines such as horticulture, breeding, biochemistry, chemistry, nutrition, food science, behavioral science, physiology and medical science. The objective of the workshop was to develop a curriculum for the unique multidisciplinary and multi-state course entitled '*Science of Foods for Health program* (SFFH)' and also to conduct a process evaluation of a tri-university collaborative course

involving partner institutions. The faculty development/curriculum development workshop evaluation was aimed to measure: (1) workshop quality, (2) faculty motivation about collaboration and their perspectives of the project, and (3) faculty conceptualizations of teaching and learning methods they use in their instruction. The overall faculty opinion was that workshop was very well conducted, provided participants with rich learning experience regarding the process to develop a curriculum (85% agreed), 77% of the participants stated the workshop met their expectations, especially regarding their understanding about the way the project will be conducted and completion of curriculum draft as well as 85% of them stated to have improved their knowledge about the process. Our Center hosted 13 scientists around the world, 7 industry and 5 academicians tours which helped new industry members to join the Center. Legislatures continued their support due our excellent research and educational program and scientist visit are increasing due our excellent research activities. In 2006-07, VFIC scientists published 17 peer reviewed publications, 9 book chapters, 3 proceedings, and 34 abstracts. In addition, scientists presented their research findings in 60 international, national, state, regional professional and industry meetings. Industry presentations impact the commodity groups and consumers in their decision to change lifestyle. I have chaired and/or co-chaired four major national/international conferences related to Foods for health and president/chair elect for three professional organizations. As a Center, we were able submit 18 external grant proposals with 9 proposals received funding and I have submitted one proposal to the USD-CSREES. VFIC hosted for the first time national onion symposium.

Dr. David Wm. Reed, Professor

In teaching, Dr. Reed has developed the beginning undergraduate horticulture course into one of the most popular and respected science core courses in the university. Over the past 29 years, Dr. Reed has taught over 15,000 students. At the graduate level, his course on applied physiology of horticultural crops has received similar recognition as evidenced by requests to teach it in Sri Lanka and Mexico. The excellence of Dr. Reed's teaching has been recognized by having received virtually every teaching award given by his college, university, and regional and national scientific society.

In research, Dr. Reed has trained 10 Master and 8 PhD students, published 41 refereed scientific journal articles, 62 scientific abstracts, and procured over $600K in grants.

In service, Dr. Reed has served as Interim Head on 4 occasions, served as President and Secretary-Treasurer of his regional scientific society, written a widely utilized text for greenhouse growers, and presented over 100 talks at grower and producer conferences, trade shows and educational meetings.

Dr. Terri Starman, Associate Professor

The overall goal of my research program is to promote sustainability by combining the reduction of resource inputs with information transfer between growers and consumers to facilitate the selection of high-value, high-demand crops for time-efficient, energy-saving, cost-effective greenhouse production of high quality, long-lasting floral products. Two products we are working with are Dendrobium orchids and Container Gardens.

The USDA reported that in the United States, the wholesale value of potted orchids increased from $47 million in 1996 to $139 million in 2005 (USDA, 2007). The world's production of pot orchids was forecasted to continue increasing at a steady pace to reach a total of 305 million pots by 2014. Dendrobium was reported to be the second most valued orchid genus sold in Japan in 2002, which had a market share of 20%, only behind Phalaenopsis (Laws, 2004; Wang, 2004). Dendrobium has also been reported to be the most economically important flowering pot orchid genus sold in Hawaii with a wholesale value of $6 million in both 2005 and 2006 (USDA, 2007). Our research is supporting this expanding and profitable industry.

Container gardening is one of the more promising categories of the lawn and garden market (Miller, 2001). Twenty-nine million households participated in container gardening in 2005, five million more households than the previous five-year average of 24 million. Total retail sales for container gardening in 2005 were $1.3 billion, three percent more than the five year average (National Gardening Assn., 2006). Sales of products related to container gardening have been one of the fastest growing lawn and garden categories in the past five years (National Gardening Assn., 2006). Container gardening popularity is likely due to the increase in high-density housing and patio or deck gardening (Miller, 2001). Container gardens offer the benefits of gardening in minimal landscape space using a minimum amount of water.

Dr. Astrid Volder, Assistant Professor

Relevance

Urban and natural green areas provide a wide range of ecosystem services to the community. Increased urbanization, encroaching parking lots and concrete areas, as well as increasing temperatures and a reduced frequency of rainfall, combined with intensification of individual events will impact these green spaces and their capacity to continue provide a wide range of ecosystem services. Little is known about the effects of the urban environment and climate change on semi-natural plant communities that are within urban areas or at the sub-urban-rural

interface. Research in this area will make us better prepared to handle future challenges. This lab aims to conduct a wide range of experiments on the effects of climate change and urbanization on plant communities. Currently, two problems are being addressed by this program. (1) Southern oak-savanna represents an ecological tension zone that separates the grasslands of the Great Plains and the deciduous forests of the eastern US. It is an area where the effects of climate change may be particularly strong, as the dominant growth forms represent very different plant functional types. In addition, southern oak-savanna is being invaded by *Juniperus virginana*, a very invasive evergreen species. (2) As urbanization is increasing, lots with established trees are converted into areas with impervious pavement (e.g. parking lots). Generally mature trees are removed and replaced with juvenile trees that give little shade and often die within a few years. Maintaining the mature trees in the landscape would provide great benefits in terms of reduced replanting cost, additional shade (cooling) and general aesthetics.

Response

(1) We have developed a large replicated experiment, starting in 2004, where we test the effects of increasing temperatures and changes in rainfall dynamics on plant interactions in remnant southern oak-savanna. This project was funded by the National Institute of Global Environmental Change (NIGEC, 3 years initially) and then by the National Institute for Climate Change Research (NICCR, 4 years, until 2010). This project is providing training for one MSc student and one PhD students.

(2) An experiment was established to test the effects of porous and non-porous concrete on the growth and general physiological health of mature trees. This project is training one graduate student (MSc) and one undergraduate student.

Results

The oak-savanna project has yielded seven high profile presentations at the Ecological Society of America annual meeting (2005, 2006, 2007) so far. In addition, one international presentation (2006) was given at a meeting in Copenhagen, Denmark. One manuscript has been published, two manuscripts are in an advanced stage and several more are in the planning stages. Two graduate students are being trained, four undergraduate students have received research training, and collaborative efforts have been developed with Dr. Russel Monson (University of Colorado) and Dr. Gunnar Schade (Atmospheric Sciences, Texas A&M University).

The concrete project is in its first year and is a collaborative project with Dr. Todd Watson (Dept. of Ecosystem Science and Management, Texas A&M University). This project provides scientific training for one graduate student (MSc) and one undergraduate technician and posters have been presented at the American Society for Horticultural Science (ASHS) annual meeting in 2007, as well as at the Texas chapter of the International Society for Arboriculture (ISA) in 2007. The program has facilitated promising collaborations with a local water scientist (Dr. Aitkenhead-Peterson, Soil and Crop Sciences) in the area of urban water management, as well as with Dr. Bruce Dvorak of the Department of Landscape Architecture in the area of green roof technology.

Looking ahead

We will expand our research capacity to address such topics as efficient water and nutrient use in pecan orchards (with Dr. Lombardini) and woody landscape plants (with Dr. Arnold). We will also continue networking with colleagues at Texas State University (Dr. Susan Schwinning) and the Wildflower Center (Dr. Mark Simmons) as part of the Central Texas Ecology initiative, as well as further explore the areas of urban water management and green roof research.

Dr. Jayne Zajicek, Professor

Undeniably, society has a strong affection for nature and plants; the resulting economic implications have contributed to the growth of the horticulture industry. While generally accepted, this relationship and attraction for plants is virtually undocumented. Research exploring this attraction and need for green surroundings is minimal, and the relationship between people and plants is vastly unknown. Throughout history, the horticulture industry has predominately focused attention and research on the production of quality horticultural crops. However, to fully appreciate the significance of plants and the horticulture profession, horticulture needs to join with psychology, sociology, education, and nutrition (all of the sciences of people) to gain a view of the role played by horticulture plants in this world. If people/plant interactions did not occur, people would not be attracted to plants, and thus, would not be willing to pay money for them. Consequently, commercial horticulture could not exist

Program Definition and Goals:

The goal of the Growing Minds Research is to develop and conduct sound scientific research projects in the following areas:

1) evaluate school gardening as an instructional method in discipline areas including, but not limited to, science, math, nutrition, environment, and parental involvement.
2) evaluate school gardening as a method of fostering the development of leadership life skills.
3) evaluate the effects of gardening and horticulture on additional populations including youth-at-risk and the elderly.

Research Accomplishments:

Research published by the Growing Minds Research Program has documented the benefits of gardening and green spaces on children, college students, and the elderly. Specifically, children that garden or participate in outside activities have better environmental attitudes, better nutritional attitudes, better academic performance, and higher self esteem. Higher quality of life for college students, office employees, and the elderly has been reported when these populations have access to green spaces, participate in gardening, or are exposed to plants and gardening either directly or indirectly

METRICS REPORT HIGHLIGHTS
Department of Horticultural Sciences, FY 07

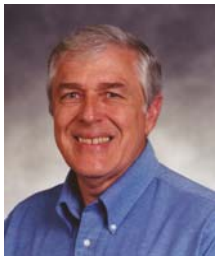
- Number of refereed journal articles published=50
- Number of book chapters authored/co-authored=12
- Number of published abstracts=85
- Number of published conference proceedings=17
- External funding generated=$3.26 million
- Number of patent disclosures=2
- Number of postdoctoral scientists and visiting scientists hosted=22
- Number of graduate degrees awarded=10
- Number of invited presentations made by faculty members=53
- Number of undergraduate students involved in research projects=29

Honors/Awards/Special Recognitions Received by Department of Horticultural Sciences Faculty, Staff & Students, FY 07

General/Leadership:

--Four current faculty members are **Fellows** of the American Society for Horticultural Science, highest honored bestowed upon members (Tim Davis, Fred Davies, Dan Lineberger, Creighton Miller)






--Dave Reed, serving as Interim Department Head for the Department of Agricultural Leadership, Education, and Communication at Texas A&M effective January 1, 2008

Research:

--11 faculty have served as Associate Editors for scientific journals (Wayne Mackay—*HortScience* and *Scientia Horticulturae*, Raul Cabrera—*HortScience* and *Scientia Horticulturae*, Jayne Zajicek—*Journal of Environmental Horticulture*, Yin Tung Wang—*Journal of Environmental Horticulture*, Mike Arnold—*Journal of Environmental Horticulture*, Brent Pemberton—*HortTechnology*, Dan Leskovar—*Journal American Society for Horticultural Science*, Kevin Crosby—*HortScience*, Brent Pemberton—*Journal American Society for Horticultural Science*), Charles Hall—*HortTechnology*, Stephen King—*Journal of American Society for Horticultural Science*

--Ndambe Nzaramba, Tom Slick Graduate Fellowship

--Fred Davies, TAES Faculty Fellow

--Fred Davies, designated Fellow, International Plant Propagators' Society

--Lavanya Reddivari, a Ph.D. student, received a 2007 Association of Former Students Distinguished Graduate Student Award for Excellence in Doctoral Research.

--Sara Simpkins, First place in the undergraduate student paper competition held at the Texas A&M annual Agriculture Conference

--Sheetal Rao, Third place award at the student poster competition held during the Texas A&M Agriculture Conference

--Jennifer Waters, Second place winner in the Ph.D student paper competition at ASHS-SR meeting held in Mobile

--Jennifer Waters, a Ph.D. student, received a Tom Slick Fellowship, 2007

Teaching:

--Texas A&M Horticulture Club was recognized as the Outstanding Large Club in the nation by the American Society for Horticultural Science

--Dan Lineberger, Distinguished Achievement Award for Teaching, Texas A&M Association of Former Students

--Dan Lineberger, Vice Chancellor's Award in Excellence for Undergraduate Teaching, Texas A&M University

--Monica Robinson, recognized as the Hammett Outstanding Association of Collegiate Branches Member for ASHS-SR

--Dr. Mike Arnold, Texas A&M Association of Former Students Distinguished Teaching Award, 2007.

--Ndambe Nzaramba, a Ph.D. student, received a National Potato Council Auxiliary Scholarship, 2007

--Monica Robinson, undergraduate student, received the Texas Plant Protection Association (TPPA) Scholarship, 2007

Extension/Outreach:

--Julian Sauls, Arthur T. Potts Award, Lower Rio Grande Valley Horticulture Society

--Russ Wallace, John E. Hutchison Award for Young Extension Professional, American Society for Horticultural Science, Southern Region

--Sharon Reed received a 2007 Hometown Hero Award from the Bryan/College Station Convention and Visitors Bureau for her work in the TAMU Horticulture Gardens