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EXECUTIVE SUMMARY

The Department is proposing a number of significant changes (beginning with the department name) in planning for the next several years. " Plant Science and Entomology" reasonably identifies the current composition and activity of the department and reflects its strong plant-oriented tradition. In response to enormous declines in personnel and resources, we have reduced and sharpened our research focus and consolidated course offerings and outreach programs. We plan combined research/outreach programs in three areas: 1) Sustainable Landscapes, 2) Arthropod-vectored Diseases, and 3) Management of Invasive Species.

We maintain separate listings for plant science (PLS) and entomology (ENT) courses. The entomology curriculum will remain largely unchanged except for minor rescheduling and 400/500 level course numbering. The plant science curriculum is greatly changed: 19 courses are dropped and 4 new ones are added in the current plan (which will be further refined over the next several months). The PLS changes are needed to bring course offerings in line with existing faculty positions and to expand our graduate offerings in the plant sciences and plant pathology. We will increase student enrollment by placing our best instructors into our introductory (Gen. Ed.) courses and seeing that we get proper credit for teaching these courses (eg. entomology). Well-taught large-enrollment introductory courses should feed more students into our entire curriculum.

We will enhance our program in ornamental horticulture through the addition of a new faculty position in Horticultural Biotechnology. We have identified the turf breeding and selection program as central to our departmental mission and propose a second faculty position, a Plant Physiologist in support of the program in turf and ornamentals. A third faculty line, an Invasives Ecologist will serve our needs for a weed scientist and play a key role in our efforts to manage invasive species. We also define a new entity: "URI Diagnostics" to serve as the single point of contact for all our diagnostic services, including our turf, tick and mosquito programs. It is essential to department programs that we reverse the long-standing trend of losing support personnel and letting facilities deteriorate. The greenhouses need major renovation and additional staff support and the East Farm operation is under-staffed.

Our program in arthropod-vectored diseases has identified several new initiatives including five new positions and expanded and reconditioned facilities in Woodward hall. Included among these positions is an Insect Physiologist/Biochemist that will round out our entomology program as a whole.

As this strategic plan is implemented, we are confident that our undergraduate and graduate enrollment will grow, our faculty will continue to excel in research and extramaural funding, and our outreach programs will continue to meet the needs of our clients. Our department is committed to the strategic planning process and will work with the College Administration and other CELS departments to develop and advance the CELS and Land Grant Mission.

I. VISION AND MISSION

Vision:

The Department seeks national standing for applied research and practical outreach and teaching in insect and plant management programs directed at protecting our health and our environment.

Mission:

Research and Outreach. Our research and outreach programs will focus in three areas:

a) Increasing sustainability of managed landscapes by developing plants with reduced maintenance requirements and by promoting environmentally-sensitive management methods including pest controls.
b) Management of arthropod-vectored diseases of humans, concentrating on those vectored by ticks and mosquitoes.
c) Management of invasive plants, insects, and pathogens.

Teaching. Our undergraduate teaching program will prepare students for careers in ornamental horticulture and turfgrass management, and provide support courses in our academic disciplines for other undergraduate majors, including those preparing for advanced degrees. Our graduate teaching program will provide traditional academic training in entomology, horticulture, plant pathology, and plant science, emphasizing interdisciplinary approaches and contemporary research techniques for the degrees of M.S. and Ph.D. in Environmental Sciences.

II. CURRENT STATUS

Historical Perspective

The Department has undergone many reorganizations and name changes over the past three decades and in its present configuration (Table 1), represents several of the traditional academic disciplines common at Land Grant universities including: Agronomy, Entomology, Horticulture, Plant Pathology, Plant Science, and Weed Science. Since 1972 these disciplines have seen a 59% decrease in tenure-track faculty, a 69% decrease in URI-supported staff, and a 73% decline in AES and Teaching assistantships (Fig. 1) With ever-dwindling resources, the Department has reduced its scope, eliminating nationally prominent programs in fruits, vegetables, and floriculture; and drastically reducing numbers of faculty in other disciplines, particularly horticulture which has gone from nine to one (Fig. 1). The number of tenure-track entomologists in the Department has increased from two to five in the past 30 years, but the Biology Department (formerly Zoology) has lost two entomologists to retirements, and because of administrative responsibilities (Pesticide Applicator Training, IPM Coordination, Program Leadership, Department Chairmanship, etc.) the University has roughly the same FTE's available for research and teaching in entomology as in the past.

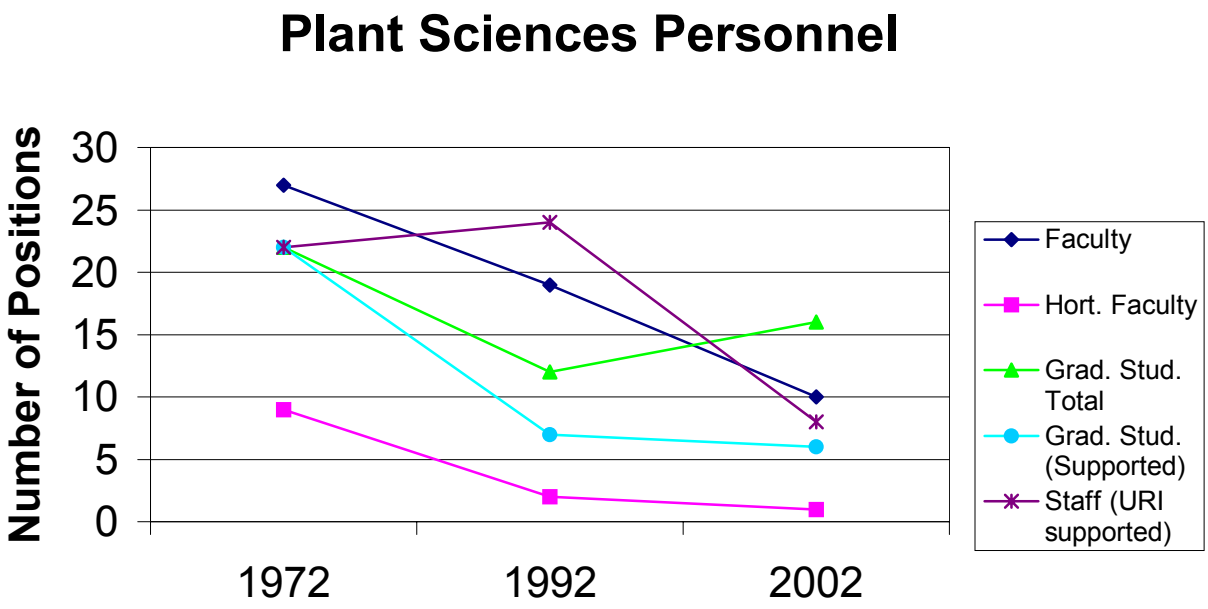

Figure 1. Plant Sciences Personnel changes over the past 30 years.

Table 1. Plant Sciences Continuing Faculty as of January, 2002

		Time Distribution				5-year Productivity	
Name	**Discipline**	**Teach.**	**Res.**	**Ext.**	**Courses[1]**	**Articles[2]**	**Grants[3]**
Full Professors							
S. Alm	Entomol.	50	25	25	3	11	457,208
R. Casagrande	Entomol.	12	25	50	2.5	11	510,806
R. LeBrun	Entomol.	65	25	10	3	11	310,000
P. Logan[4]	Entomol.	15	85	0	2	-	-
T. Mather	Entomol.	33	50	17	3	15	3,602,808
W.M. Sullivan	Agronomy	42	17	41	3	10	479,200
Associate Professors[5]							
L. Englander	Pl. Path.	42	33	25	3	0	250,000
B. Maynard	Hort.	44	25	31	3.5	15	552,341
B. Ruemmele	Agronomy		on leave		2.5	-	-
Assistant Professors							
Nathaniel Mitkowski[6]	Pl. Path.	25	50	25	2	-	-
Professor in Residence							
H. Ginsberg	Entomol.	U.S. Geol. Survey			2	12	1,166,700
Department Totals		**3.3**	**3.4**	**2.3**	**30.5**	**85**	**7,329,063**
		Yearly Average/Faculty Member				**2.1**	**183,227**
		Yearly Average/Research FTE				**6.4**	**563,774**

Footnotes:
1. All regularly scheduled courses (excluding special problems, internships, seminars)
2. Refereed journal articles
3. Not including Hatch funding
4. 100% Administrative appointment during past 5 years.
5. Joel Chandlee has a joint appointment with primary assignment in the CMB dept.
6. Joined faculty 8/01

Table 2. Staff and Graduate Students as of 12/2001

Plant Sciences Staff

Name	Title	Supervisor	% Grant Support
Bennett, Carol	Sr. Wo. Pr.	Casagrande	0
Browning, Marsha	R. Assoc.	Mitkowski/Englander	100
Dawson, Charles	R. Assoc.	Alm	0
Fales, Greg	R. Assoc.	Ruemmele	0
Faubert, Heather	R. Asst.	Casagrande	100
Golomb, Gail	R. Asst.	Mather	100
Johnson, Bill	R. Assoc.	Maynard	50
Krishanamuthy, M.	R. Asst.	Mather	100
Miller, Nathan	R. Assoc.	Mather	100
Sawyer, Carl	R. Assoc.	Sullivan	0
Siligato, Peg	Tech. Staff.	Alm	100
Takeda, Tsutomu	Post. Doc	Mather	100
Tewksbury, Lisa	R. Assoc.	Casagrande	50
Timpson, Donald	Sr. Gardener	Ruemmele	0
Wallace, David	Educator III	Casagrande	0

Plant Sciences Graduate Students

Name	Major	Degree	Supervisor	Support
Barden, Sandra	Entomol.	MS	Ginsberg	Self
Basu, Chhandak	Mol. Gen.	M.S.	Chandlee	AES
Brunkhurst, Emily	Entomol.	M.S.	Logan	Self
Bushoven, John	Pl. Physiol.	Ph.D.	Hull	Fellowship
Butler, Mari	Entomol.	Ph.D.	LeBrun	Teach.
Dacey, Jennifer	Entomol.	M.S.	Casagrande	Self
Gold, Marion	Entomol.	Ph.D.	Casagrande	Grant
Jackson, Fred	Horticulture	Ph.D.	Maynard	Self
Lambert, Adam	Entomol.	Ph.D.	Casagrande	Fellowship
Lussier, Christine	Entomol.	M.S.	Ginsberg	AES
Owen, James	Horticulture	M.S.	Maynard	Teach.
Pardanani, Neeta	Entomol.	M.S.	Mather	AES
Simpson, Peter	Horticulture	Ph.D.	Maynard	Grant
Steinback, Jacqui	Entomol.	Ph.D.	Ginsberg	Grant
Wang, Yuexia	Mol. Gen.	Ph.D.	Ruemmele	AES

Quality of Teaching Program

The Department is noted for the number of courses taught and the quality of its teaching program. Over the past decade three of our faculty have been honored as CELS (CRD) Teacher of the Year (Englander, Maynard, LeBrun). Excellence in teaching has also been noted at the university level (LeBrun – 2000, URI Teacher of the Year), regionally (LeBrun – 2000, Entomology Society of America) and at the state level (LeBrun - 2001, Carnegie Award). Our students often note their satisfaction with our teaching efforts, and

our SET scores are among the best in the University, averaging 4.45 overall for undergrad PLS courses in F2000.

Our undergraduate majors in ornamental horticulture have experienced good success in obtaining positions in their fields immediately upon graduation. For example, over the past 8 years, we have placed all 130 of our Turf Majors in permanent positions before graduation.

Our Graduate students have met with similar success. Among our recent Ph.D.s, 8 are presently in faculty positions at other universities (Drummond, Cisar, Liburd, Devine, Landschoot, Dernoden, Lim, Choi) and all that have sought employment or additional degrees within their fields, have been successful. Graduate student numbers declined along with assistantship support for several years, but rebounded recently in response to expanded research opportunities and a graduate curriculum in entomology (Fig. 1).

Research Productivity

By the traditional measures of productivity, refereed journal articles and grant dollars, our department faculty is quite successful (Table 1). We average about 2 journal articles and about $180,000 per year per active faculty member. Performance is much higher when evaluated on a basis of research FTE's because our department has a large teaching and extension commitment with only 3.42 FTE for research among 10 faculty. We are known nationally and internationally for our research on vector ecology, plant propagation, and biological control.

We place a high value on the national standing and external reputation of our research and outreach programs among peers in academic departments and professional societies. We also measure ourselves in the eyes of select stakeholders—University administrators, taxpayers, growers, consumers, environmentalists, economic developers, and students—from whom we seek feedback on the direction, quality, and value of our efforts.

Quality of Cooperative Extension Programming

Our outreach program is based on outcomes realized when target audiences use the results of our research. Research and outreach priorities are driven by stakeholders, from whom we seek advice and feedback. Outreach is based on research, and our programs in research and outreach are integrated. Most faculty in the department have 3-way appointments and the department has several very effective CE programs. Our turf program, the oldest in the nation, holds an annual Turf Field Day attended by 2000 clients from throughout New England. Our IPM program has been addressing the needs of Rhode Island growers since 1978. Dr. Casagrande received an award from the Entomological Society of America in 2000 acknowledging the excellence of that program, among the most innovative in the country. Our Pesticide Applicator Training Program (Dr. Alm) is another very effective program in which all licensed pesticide applicators in the state receive training from URI. Our entomologists also work closely with the state and with communities in managing mosquitoes and ticks that are important disease vectors.

Arguably our most successful CE programming is a result of a very successful liaison with the CE Center. The Center organizes and coordinates most of our training programs in ornamental horticulture through its GreenShare, Learning Landscape, and Master Gardener programming. These activities will be described in the CE Center's strategic plan. From our perspective, it has been a very effective and productive liaison.

The RI Green Industry (nursery, landscape, arboriculture, turfgrass management, etc.) relies heavily on the outreach efforts of our faculty with extension responsibility (Maynard, Englander, Mitkowski, Casagrande – Nursery and Landscape Industry; Alm, Sullivan, Mitkowski – Turf Industry). Our CE faculty routinely present research and management recommendations to the industry, publish in industry press, and conduct practical, problem solving research to address critical industry concerns. Our CE faculty appear on television throughout the year and are consulted by the press on horticultural and environmental issues of concern to Rhode Islanders.

Departmental Strengths

Our greatest strength is the quality and industry of our faculty who, in turn, foster quality students and productive programs. We have particular faculty strength in entomology at present, including several internationally prominent scientists working on insect-vectored diseases and biological control. We have internationally recognized expertise in ornamental horticulture and a long tradition of turfgrass research. Our teaching program in turfgrass management is popular and results in virtually 100% placement success following graduation. We have good facilities for field research in turfgrass, horticulture, and agronomy, and adequate greenhouse space, although there are serious constraints reducing effective use of these facilities. Our department has a great strength in outreach. Most faculty have three-way appointments where we serve industry and consumer needs -- particularly in ornamental horticulture and in managing insect-vectored diseases.

Departmental Weaknesses

We have lost many of the faculty and support positions that were formerly associated with this department and hence are unable to offer many of the programs and services that traditionally have been expected by stakeholders. This is viewed by many as a weakness. Even after substantially refocusing our programs in response to current needs and limited resources, we still find shortcomings that must be addressed, including a lack of key faculty positions in horticulture and in turfgrass breeding, inadequate facilities and equipment and lack of support personnel. Each of these weaknesses will be addressed in this strategic plan. Despite its value to the horticulture industry and public, some might view our strong outreach program as a weakness since, necessarily, it dilutes our teaching and research efforts. Many universities now shun the three-way appointments that appear to be the norm in our department.

III. GOALS

A. Overall

We seek to develop and promote practical solutions to real problems of regional and national/international importance. We will accomplish this through roughly equivalent efforts in teaching, research, and outreach. With limited faculty resources, this will generally require 3-way appointments with closely linked research and outreach efforts.

B. Research and Outreach

The following series of program descriptions are organized under our three Departmental Initiatives: Sustainable Landscapes, Management of Arthropod Vectors of Human Disease, and Management of Invasive Species.

Sustainable Landscapes -Plant Development:

OVERALL FOCUS: Our research and outreach emphasizes sustainable landscapes. That means that we focus on development of plant materials that are economical to grow and maintain— in home, work, and recreational plantings—and that require a minimum of water, fertilizer, or pest control chemicals, to minimize the environmental impact of landscape plant management. Development of plant materials includes selecting, breeding or modifying plants through biotechnology, and promoting market acceptability through outreach. Without excluding work of scientific or economic value on any crop, the department intends to retain traditional strengths in research and outreach on ornamental horticulture and turfgrasses, as is appropriate for Rhode Island's agricultural production base. [A case in point is our renewed interest in potato breeding where we feel our unique insight into the genetics of Colorado potato beetle host recognition may be useful in developing resistant varieties.] Our perspective on the environment is long range and geographically broad. We are concerned with conserving nonrenewable fossil fuels and organic fertilizer stocks. We want to be on the leading edge in development and use of biotechnology, including use of genomic and transgenic research tools, while at the same time taking a responsible lead in addressing public concerns about introduced transgenic plants.

Trees and Shrubs

Research Focus - The focus of the plant development program is to develop or obtain, and evaluate, novel ornamental plant germplasm for use in New England landscapes. Priority is given to trees and shrubs suitable for cultivation by RI growers and for use by RI landscapers. A second focus is to obtain and evaluate plant materials that may be substituted for pest-prone taxa, such as salt-tolerant conifers suitable for replacement of Japanese black pines dying along the RI seaboard, and replacements for infested Canadian hemlocks. This focus is linked closely to the overall objective of the Sustainable Landscapes Program, which is to promote the use of lower maintenance,

pest-free landscape plants. RI AES is a formal participant in evaluation programs of the USDA National Arboretum, NC-7, NE-009, Landscape Plant Development Center, and J.F. Schmidt & Sons Nursery. As well, we have five new shrub taxa (RI natives) under evaluation for release and possible patent.

Goals - The goal of the plant development program is to increase the diversity of sustainable tree and shrub taxa available to the RI and NE nursery and landscape industries. By increasing the availability of germplasm, RI growers and landscapers will be less resistant to dropping less-sustainable taxa from their inventories.

Relevance to Stakeholders - The Green Industry benefits greatly from having a greater selection of plant materials to grow and offer to consumers. As we have promoted the use of sustainable plants to the public through our Outreach programs, the industry has been hard pressed to give up growing pest-prone crops that are central to their production programs. It is our responsibility to evaluate concurrently the plants we promote, including production and marketing issues, for the industry. Plant Selection and Development have been identified as priority concerns by the Rhode Island Nursery and Landscape Association, New England Nursery Association, and Horticulture Research Institute.

Outreach Program - Tree and shrub evaluation is conducted at the RI AES East Farm, as well as at test sites sited around the state to take advantage of mesoclimactic conditions (eg. salt spray tolerance). We regularly engage the industry to participate in the evaluation program, through field days, twilight seminars, and presentations. This research objective is tightly linked to the Sustainable Landscapes Program, Master Gardener curriculum, and new Invasives Species Management program discussed below.

Program Needs - This program is supported through Hatch (NE-009) and extramural grant funds (RINLA, NENA, HRI, Pesticide Relief Board). Continued support by AES of farm labor staff to minimally maintain evaluation plots is critical, as plant germplasm evaluations typically take a minimum of 3-10 years to complete.

Plant Development: Turfgrasses

The Turfgrass Research program at the University of Rhode Island has a long and productive history, resulting in many improved turfgrass varieties including 'Providence', 'Exeter'and the 'Jamestown' line of grasses. The Skogley Memorial Turfgrass Research Facility contains some of the oldest agricultural research plots in continual use within the United States. New developments in turfgrass breeding technologies and agronomic techniques will ensure that the URI Turfgrass Research program remains viable in the future.

Goals - The goal of the URI turfgrass program is to develop, evaluate, and promote turfgrass varieties with increased tolerance to stress, including that caused by mowing, wear, reduced irrigation, insect and disease pests, and increased salt tolerance.

Research Focus – The development of turfgrass varieties adapted to the Northeast, with resistance to physiological and pest-induced stress, can reduce turfgrass management inputs and associated environmental impacts. In addition, URI turfgrass research provides for the development of turfgrass varieties specifically adapted to New England, serving an under-represented stakeholder group. Breeding research at URI focuses on the development of improved varieties of bentgrass (*Agrostis* spp.) and fine leaf fescues (*Festuca* spp.), species particularly well-suited for our area. Evaluation of the local fitness of turfgrass varieties developed elsewhere is also a very important part of the research program.

In collaboration with Hybrigene LLC, genetic transformation of turfgrasses is being undertaken to reduce the time required for traditional breeding and to increase the number of useful genes placed into any particular variety. Traditional breeding methods are also being used to identify and screen potentially useful germplasm. Revenues generated from the development of improved turfgrass varieties return to the University and the turfgrass research program to aid in future research and development.

The turfgrass research program at URI also examines the improvement of turfgrass management techniques, develops strategies to decrease the impact of turfgrass systems on the environment and aids in the coexistence of agricultural and urban areas. The majority of this research is undertaken at the Skogley Memorial Turfgrass Research Facility and its continued support is critical to the success of the URI turfgrass research program.

Relevance to Stakeholders – Golf course superintendents, sod growers, sports turf managers and the public benefit directly from the development of new germplasm and the development of new techniques to reduce the effects of turfgrass management on the environment.

Outreach Program – The results of turfgrass research can often be applied directly to public needs and our faculty interact directly with stakeholders through extension meetings, Turf (and Sod Grower) Field Days, New England Regional Turf Conference (in Providence), numerous publications and site visits. Faculty also participate routinely in educational programs administered through the C.E. Center (Master Gardeners, GreenShare, and special programs).

Program Needs – The strength of the URI turfgrass program has been weakened seriously by retirements, but we retain key elements, including a turf breeder, an agronomist, a turf pathologist and turf entomologist. The most critical position in the turfgrass research program is the plant breeder, who may be considered the core of the group. The current lack of a plant physiologist is a shortcoming of the turfgrass program and the Department as a whole. A plant physiologist is needed to identify specific enzymes and genes involved in stress tolerances and is a key element in a program to enhance stress tolerance. In addition, it is necessary for the program to receive continued support for (and access to) the Skogley Memorial Turfgrass Research Facility. Without

this or a similar facility, turfgrass research would be impossible, and a significant source of revenue and research, teaching, and outreach activity will be lost.

Sustainable Landscapes - Plant Management : Trees and Shrubs

Research Focus - Our department (Maynard & Johnson) participates in regional Hatch project S-290, and in the period 2002-2004 will focus on efforts to increase the efficiency of novel methods, developed at URI over the last 5 years, for clonally propagating trees and shrubs using less water and chemicals. Secondly, we will build on recent research evaluating the treatment of nursery fertilizer and chemical runoff using ornamental plant biofiltration systems that produce a saleable crop while addressing pollution concerns. We will evaluate the loss of nutrients and pesticides through above-ground and pot-in-pot production systems using a newly developed total-capture irrigation system, and modify our treatment biofilter systems to effectively treat documented rates of point-source pollution. Finally, we will continue efforts to reduce the impact of growing deer populations on the Green Industry by evaluating and devising solutions to the problem of deer damage to trees in nurseries and landscapes, specifically that caused by antler rubbing.

Goals - Our research goal is to increase the efficiency of plant production and management methods for the RI and NE Green Industries. Specifically we are addressing novel methods of plant propagation , the mitigation of pollution runoff from nurseries, and the impact of deer browsing and rubbing on plant production and maintenance in the landscape.

Relevance to Stakeholders - Nursery and landscape organizations at the state, regional and national levels have all identified production efficiency, water quality and wildlife control as top issues for research by Land-Grant institutions. This focus is linked closely to the overall objective of the Sustainable Landscapes Program, which is to reduce chemical, water, labor and other inputs to public and homeowner landscapes, and to the research and outreach goals of the URI Sustainable Communities Initiative.

Outreach Program - Results of this research are disseminated to the Green Industry through a variety of outreach channels, including newsletters, popular and research articles in national-level professional magazines, refereed publications, and presentations at conferences and short courses.

Program Needs - This effort is supported through Hatch S-290 and extramural funding (RINLA, NENA, HRI). Additional support is needed in the area of horticulture outreach to the industry, to alleviate the impact of a three-way split on the one faculty member (Maynard) responsible for the bulk of this effort. A portion of this relief comes from William Johnson (Research Associate IV), but this alone is not sufficient.

Sustainable Landscapes - Pest Management : Trees and Shrubs

Goals - Our outreach and research programs here are closely related. Our first effort has been to get producers and users of nursery plants to avoid pest-prone plants and use pest-resistant alternatives. To this end, we have produced and widely distributed a URI bulletin that lists and describes ornamental plants that are sustainable in this region. We have also facilitated locating these plants through the publication of a RI Nursery Stock Source List. Revision and promotion of these lists is an ongoing process.

Research Focus - In addition to evaluating pest resistance in ornamental plants, we are researching biological control of key nursery pests, including the hemlock woolly adelgid and the birch leafminer. (Discussed under Invasive Species – Biological Control.) Research on plant pathology in trees and shrubs is derived from both local needs (eg. *Phytopthora* on Rhododendrons) and national problems (eg. Sudden Oak Death). Locally, Rhododendrons provide a major revenue source for nurseries. Unfortunately, they are highly susceptible to *Phytopthora*, which causes significant losses annually. We are striving to identify and quantify resistance to this disease in available germplasm.

A problem commonly seen problem in commercial apples is “apple replant disease”. This disease complex is found nationwide and frequently makes it impossible for growers to plant new trees in established orchards. While it has yet to be identified on crabapples, it is likely that it does occur on them. Crabapples are planted widely in the Northeast and a crabapple orchard exists at the University of Rhode Island. Using this facility as a resource, we are attempting to determine the severity of apple replant on crabapples and appropriate management strategies for landscapers and homeowners wishing to grow crabapples.

A new fungus species was found recenty to be causing rapid death of oaks in California (Sudden Oak Death). The fungus has been found since on a multitude of under-story shrubs, forest trees, and woody nursery plants, with the host list growing by the week. Nursery crops frequently are moved about the country and may act as vectors of the disease, potentially devastating oak forests and urban/landscape plantings throughout North America. Despite severe quarantines against movement from affected areas in California, the pathogen has been found killing trees in Oregon (a major source of plant materials for the RI Green industry). The USDA recently funded a cooperative project between URI (L. Englander) and the USDA-ARS Plant Quarantine facility in Ft. Detrick MD to provide essential knowledge about the environmental and biological parameters of this pathogen.

This work on Sudden Oak Death is a good fit with the present and future research and outreach mission of CELS. It supports the critically-important need for basic research about this new pathogen. Additionally, it directly supports the needs of RI’s major agricultural stakeholders (the green industry) which, along with those in other states, stand to be impacted severely by regulatory measures for this pathogen.

Relevance to Stakeholders - Stakeholder input largely drives our programs in pest management in ornamentals. We meet frequently with RINLA members, both formally (research committee) and informally to determine their research needs.

Outreach Program - This program has many outreach venues including the URI GreenShare program, locally-produced articles (RINLA Newsletter), seminars, presentations at RINLA meetings, and the annual Disease-Resistant Crabapple Open House.

Pest Management : Turfgrasses

In Rhode Island, approximately 4,000 acres are planted to sod annually with an approximate value of $32 million. In addition, approximately 30 public golf courses exist within the state of Rhode Island. Across New England, almost 650 public golf courses exist and contribute hundreds of millions of dollars to local communities in tourist and recreation dollars. Diseases and insect pests pose a considerable threat to the viability of both golf courses and sod farms. The research conducted at the University of Rhode Island is in direct response to local and national turfgrass problems with the overall goal of managing these pests economically while having a minimal impact on environmental health and thereby satisfying the needs of a diverse array of stakeholders.

The goal of the turfgrass disease research program at the University of Rhode Island is to develop strategies to manage stress related diseases of turf. In the Northeast, golf course turf is managed intensively and is susceptible to a number of pathogens. Susceptibility is often directly related to physiological stresses including mowing height, compaction and drought. Research will attempt to identify new and evolving stress related pathogens, determine their significance and develop integrated management strategies to lessen disease pressure. Organisms that will be addressed include *Cephalosporium, Leptosphaerulina* and other fungal species. Nematodes are a perennial stress related pathogen on turf in New England and the diversity and management of turf nematodes will also be explored. In addition, research will examine the biology and control of bacterial blight of bentgrass, an emerging disease, and diseases of ornamental grasses (which are now becoming increasingly common in the Northeast) will also be examined. Fungicide efficacy trials, which have been an important part of the URI turfgrass research program, will be continued to provide current information as to the utility of specific fungicides and the incidence of fungicide resistance in Rhode Island.

The goal of the turfgrass insect research program is to continue to develop biological (entomopathogenic nematodes, bacteria) and least-toxic (pheromone mating disruption) methods for control of major turfgrass insect pests in the Northeast. The CE center receives over 2,000 calls each year regarding control of white grubs infesting turfgrasses. Through our research efforts we are able to provide the latest control information to homeowners, golf course superintendents (via Turf Field Day, The NE Regional Turf Conference, and monthly meetings, landscapers (via GreenShare, RINLA Short Courses and Pesticide Applicator Training programs), and sod growers (Turf Field Day).

Outreach is a major component of the work carried out by turf disease and insect faculty at URI. The Turfgrass Disease Identification Clinic services golf course superintendents, sod growers and home owners from within the State of Rhode Island and around the region. Disease diagnosis is made by faculty and technicians and the most effective management strategies are communicated to stakeholders. In 2001, approximately 300 disease samples were processed at this laboratory. This is one of only two turfgrass diagnostic laboratories in New England. Insect identification and control recommendations are made though the turf insect program in a similar fashion. All faculty contribute annually to various turfgrass and ornamental meetings in Rhode Island (RINLA, NE Regional Turfgrass Meeting, NE-171 Regional Nematology Meeting, Pesticide Applicator Training, etc.) In addition, faculty are involved in site visits throughout the year to aid in the management of special problems.

Program Needs - The turf disease and insect research programs currently are adequately supported through external grants and AES funding. However, additional funding and an FTE slot to support technical staff for the Turf Disease Diagnostic Clinic are needed.

Management of Arthropod-Vectored Diseases

Vector-Borne Disease – *Overview*

Diseases transmitted by ticks and mosquitoes are a cause of significant concern for Rhode Islanders, just as they are for residents of, and visitors to, much of the northeastern quadrant of the United States. Neither the densely populated urban centers, nor surrounding suburban and rural portions of the region are immune to vector-borne disease. A century-old process of reforestation combined with more recent demographic shifts towards suburban lifestyles have facilitated the emergence of several serious tick-transmitted infections within the region, while the physical geography of the region supports a relatively diverse and typically abundant mosquito population bringing its own health risk. The recent introduction of West Nile virus into the northeastern United States from half a world away has revealed just how vulnerable the region is to public health threats from arthropod-associated human and animal pathogens.

The current research capacity for responding to vector-borne disease threats in Rhode Island is largely contained within, or affiliated in some way with the existing Plant Sciences Department and the Center for Vector-Borne Disease. The focus of the current program generally falls into four research and outreach areas: 1) enhancing disease and risk surveillance; 2) improving diagnostic tools and capacity; 3) elucidating vector/microbe and vector/host interactions for the purpose of disease prevention and control; and 4) developing, implementing, and evaluating community-based disease prevention strategies. Faculty contribute to the statewide effort currently organized within the Departments of Environmental Management and Health; as well faculty currently provide critical expertise, testing capacity and facilities, and man-power to the statewide vector-borne disease program, and to Federal programs.

Research Focus - *Current Programs*

The current faculty enjoy international reputations in areas related to tick biology and tick-borne disease ecology, and invertebrate pathology. They also possess extensive mosquito biology and control expertise.

Ticks - Professors Mather, Ginsberg and LeBrun maintain the largest programs focused on ticks, including aspects of tick biology, ecology, and control. Specific research goals are (1) to identify environmental and biological factors that determine the epidemiological pattern of human tick-borne disease; (2) to develop novel vaccination strategies for preventing tick-transmitted infections; (3) to identify compounds derived from ticks that possess potential pharmacological utility; (4) to develop molecular biology-based tick-borne pathogen detection assays; (5) to elucidate transmission dynamics of pathogens among tick vectors and vertebrate hosts; (6) to discover and evaluate natural enemies of ticks (especially entomopathogenic fungi, nematodes and bacteria) as potential biological control agents; (7) to assess ecological effects of tick management techniques and to develop management methods that minimize negative environmental effects; and (8) to develop greater understanding of tick immune mechanisms.

Mosquitoes - Our faculty have long-standing experience with mosquito pathology (LeBrun), ecology (Ginsberg and Mather) and surveillance and management of mosquito-borne diseases. The RI Mosquito Abatement Coordinator, Department of Environmental Management (Gettman) holds an adjunct appointment in our department. Primary research goals include (1) to develop mosquito pathogens (fungi, protozoa, etc.) as microbial control agents for mosquito management; (2) to assess ecological dynamics of mosquito-borne pathogens so that we can develop targeted management programs that efficiently lower human risk of infection with mosquito-borne diseases (such as West Nile Virus); (3) to evaluate environmental effects of mosquito control techniques, and to develop environmentally-benign mosquito control methods; (4) to develop rapid and specific diagnostic assays to identify mosquito-transmitted pathogens; (5) to develop early and accurate surveillance tools to predict human risk of mosquito-borne infections.

Currently these research objectives are achieved through on and off-campus collaborations, and by a staff of grant-funded post-doctoral fellows, research associates and assistants, and graduate and undergraduate students. There has not been any College- or University-supported technical assistance provided for these programs over the past 10 years with the exception of graduate student stipends.

Goal – There is a critical national need to build a solid public health infrastructure to protect the health of citizens nationally and locally. We seek to develop a program that contributes to the national effort of developing 'core capacity' that every public health system needs. We will create and seek to sustain a comprehensive vector-borne disease research and training program focused on: developing and validating effective disease surveillance strategies; creating sound integrated pest management systems to suppress vector populations; and on using biotechnology to develop appropriate disease prevention programs.

Relevance to Stakeholders - Human and animal diseases transmitted by arthropods cause immeasurable social and economic losses. Several of the infections transmitted by arthropods in the northeastern U.S. (Table 3) cause significant morbidity and are occasionally fatal. Lyme disease, the most frequently acquired vector-borne disease in the U.S. has caused nearly 177,000 reported cases (and perhaps 1.7 million actual cases) over the past 20 years. Factoring in the costs of diagnosis, treatment and lost wages, a recent study estimated the cost of each acute case of Lyme disease to be $161, while just the economic costs to treat the sequelae of early and late disseminated Lyme disease increases >10 to 100-fold. Social costs, including losses in tourism and recreation, pain and suffering, disability and the like further add to the toll that vector-borne diseases impose. Potential stakeholders of URI's Vector-borne Disease Program then, include those interested in being apprised of and suppressing vector-borne disease risks (citizens, visitors, small business owners, pet owners, health care providers, insurers) as well as public safety and public health authorities, and the pest control and pharmaceutical industries.

Table 3. The most common arthropod-transmitted infections in the northeastern United States and their vectors.

Lyme disease - *ticks*
Babesiosis - *ticks*
Ehrlichiosis - *ticks*
Rocky Mountain Spotted Fever - *ticks*
Dog heartworm - *mosquitoes*
Eastern Equine Encephalitis - *mosquitoes*
West Nile Virus - *mosquitoes*
Tularemia - *ticks, deerflies*

Outreach – Statewide tick and mosquito surveillance results are disseminated to public health and medical authorities, and to the general public. Faculty are involved in policy issues related to vector-borne disease at the state level. They engage in applied research aimed at evaluating pest management strategies and other public health practices. They support local and regional medical and public health community with information, training, and specialized testing capacity and facilities. They provide technical advice and research support to the U.S. Department of the Interior and serve as the primary source of vector-borne disease guidance for the National Park Service. They interact as consultants to industry, providing knowledge, research materials, and access to specialized research tools and techniques. They provide information concerning vectors and vector management to professional groups and citizens.

Program Needs - As a first step towards building the type of comprehensive program to enable the research, outreach and educational goals described, will require the following actions (further elaborated in Section IV):

1) Hire 4 junior faculty/senior level research associates to provide specific expertise, and to support current or planned objectives. (capacity building)
2) Merge statewide vector-borne disease activities, including all non-human surveillance, community outreach, etc. into the RI Ag Exp Station and Cooperative Extension. DEM and/or DOH to retain reporting responsibilities to media. (program building)
3) Increase the number of graduate student assistantships, and actively recruit graduate students into the vector-borne disease program. (workforce)

4) Improve laboratory capacity, including: renovation of current laboratories in Woodward Hall, develop core facilities supporting molecular biology, build a mosquito insectary in Woodward Hall, and reassign additional laboratory and office space to completely meet the needs of current and new staff. (infrastructure)

Management of Invasive Species

Non-native plants and animals that are introduced into North America typically come without the natural enemies that keep them in check in their native habitats. Freed from these natural controls, these aliens often reproduce and spread with abandon. Our department is addressing this issue on two fronts: a) we are attempting to reduce the risk from purposeful plant introductions, and b) we work on biological control of select insect and weed problems.

Identification and Replacement of Invasive Ornamentals

Research Focus - Of the thousands of exotic plants that were introduced and distributed in this country for horticultural or agronomic uses over the past three hundred years, several species are now widely regarded as pests. Well-known examples include kudzu, crabgrass, dandelion, barberry, and purple loosestrife. Some important ornamental plants (Norway maple, winged euonymous, Korean dogwood) have invasive tendencies, which may present problems in minimally managed landscapes. Our research focus is on continuing to identify invasive species and select, evaluate and promote suitable alternative species for the nursery and landscape industries.

Goals - Our research and outreach goals in this program are: 1) To evaluate existing and potential new ornamental plant introductions for potential invasiveness, 2) to develop ornamental plants which do not reproduce and spread in the landscape, and 3) to develop and promote plants which are non-invasive alternatives to current invasive ornamentals.

Relevance to Stakeholders - Invasive plants affect many stakeholders, as well as the ecosystems that are altered by the proliferation of non-native species. Resource managers, environmentalists, green industry professionals and the public all recognize the impacts of invasive plants and animals on native species. However, the perception of best solutions to the invasives problem varies widely among stakeholders. All agree that more research is needed on the invasiveness of the many non-native plants in cultivation, as well as mechanisms for removing existing infestations. The Green Industry plays a central role as producers of many invasive ornamental plants. It is our role to discourage nursery growers and landscapers from using known invasive plant species, and to promote the use of alternative sustainable plants.

The concept of engineering sterility into popular and commercially important ornamental plants, which also happen to exhibit invasive tendencies, is exciting and could have hugely beneficial implications, regionally, nationally, and globally.

[If current discussions for a horticultural biotechnology program, to be conducted in collaboration BMMG and Hybrigene LLC, continue to progress, we will develop proposals to address the invasive plants issue through the bioengineering of sterile cultivars of the most invasive ornamental plant taxa. Examples that would have a tremendous impact on the green industry include *Berberis thungergii*, Japanese barberry, *Euonymus alatus*, burning bush, and *Acer platanoides*, Norway maple. This would be an ideal focus for horticulture biotechnology research and infrastructure building using the recent USDA Special Agriculture Appropriation. Invasive plants are a Presidential initiative and directly impact the nursery industry.]

Outreach Program – We have actively promoted non-invasive plants and alternative species for years through the Sustainable Landscapes Program. At present, we are tightly engaged with the nursery industry on the issue of producing invasive plant species. A segment of our faculty are actively involved with the Rhode Island Invasive Species Council, and will be increasing efforts to identify potentially invasive species that are presently in production by the industry.

Program Needs - This is a new effort on the behalf of our research and extension faculty, on top of existing efforts. Support either from new staff or new faculty positions with research and extension responsibilities to the Green Industry would greatly facilitate efforts to address the invasive plant problem. A faculty position in horticultural biotechnology – developing new pest-resistant and non-invasive ornamental plants would play a critical role in several of the research and outreach areas identified herein, including the development of new germplasm for the nursery and landscape industries, and addressing important pest problems. This position would play a critical role in several of the research and outreach areas identified herein. Including the development of new germplasm for the nursery and landscape industries, and addressing important pest problems. As mentioned above, if possible collaborations with BMMG and Hybrigene LLC bear fruit, we would like the new faculty member to take the lead from our department in developing sterile versions of important, though invasive, ornamental plants. A faculty position in Invasive Plant Ecology would solidify URI's program in the management and elimination of invasive plants.

Biological control of Invasive Species

There are about 1,700 introduced insects in this country and over half of them are identified as pests. The 300 species of invasive plants in North America have already infested 100 million acres and infest another 3 million acres per year (about 4.5 times the land area of R.I.). Combined with the other exotic invasive animals (such as zebra mussels) these invasive species cause roughly 123 billion dollars in damages annually in the USA. In many cases these problems can be solved by "reacquainting" these "pests" with their effective natural enemies in a deliberate process called "Classical Biological Control".

Research Focus - We have a USDA-approved primary quarantine laboratory: the only such university-based lab in the Northeast. This facility allows us to import and study

potential biological control agents that do not exist elsewhere in North America. Our biological control programs concentrate on invasive insects and plants, particularly those of consequence to landscape plants in the Northeast. We are currently working on a range of pests including birch leafminer, hemlock woolly adelgid, lily leaf beetle, purple loosestrife, Cypress spurge, and *Phragmites australis* (common reed).

Goals - The goal of this research is to provide permanent control of key insect and weed pests and in the process, to advance the science of biological control.

Stakeholder Involvement - We select our pest problems based upon stakeholder needs presented to us by individuals (farmers, nurserymen) and organizations (North American Lily Society, Massachusetts Horticultural Society, Rhode Island Nursery/Landscape Association, Rhode Island Invasive Species Council).

Outreach Program - The biological control program has many outreach venues including the URI GreenShare program, locally-produced articles (RINLA Newsletter, Maritimes, RI Audubon Newsletter, Wild Plant Society Newsletter), presentations (RI Natural History Survey, SeaGrant and US Forest Service workshops, etc.). We regularly organize and participate in a Northeast Biocontrol Workshop through the Entomological Society of America. We provide our expertise (and our insects) to clients to solve problems with invasive species including solving the purple loosestrife problem at Roger Williams Park Zoo (and elsewhere in RI) and controlling Cypress Spurge at URI's Alton Jones Campus and at Watson Farm in Jamestown.

Program Needs – Presently the program is adequately supported through a combination of grant and Hatch funds. The Biological Control Quarantine Laboratory needs extensive alterations of its HIVAC system. This project, which is currently under design, will cost about $50,000 to complete.

C. Teaching

Our undergraduate teaching program will prepare students for careers in ornamental horticulture and provide support courses in our academic disciplines for other undergraduate majors, including those preparing for advanced degrees. Our graduate teaching program will provide traditional academic training in insect and plant sciences, emphasizing interdisciplinary approaches and contemporary research techniques for the degrees of M.S. and Ph.D. in Environmental Sciences. For graduate education, we will provide core courses for the disciplines of entomology, plant pathology, and plant sciences.

The major in urban horticulture and turfgrass management is intended to educate students in the sciences, both natural and social, in preparation for professional careers in the many fields of environmental horticulture. This program has as its unifying theme the culture and use of plants that enhance the human environment. Graduates of this program may pursue careers as landscape contractors; golf course superintendents; directors of park systems and arboreta; proprietors of garden centers and floral shops;

plant propagators; nurserymen; vegetable and fruit growers; technical representatives for seed, equipment, and chemical companies; and managers of lawn service to name some of the opportunities available. Others may enter graduate school and pursue careers in research and education in both public and private institutions. Most of our graduates find employment immediately in the horticulture industry and benefit from the Horticultural Business option, which trains students for entry-level management positions. Others do further graduate work to pursue technical, academic or research careers.

Depending on the area of specialization, graduates can meet the standards of several certification organizations. Graduates specializing in turfgrass management qualify for certification as turfgrass managers or turfgrass specialists with the American Registry of Certified Professionals in Agronomy, Crops, and Soils, (ARPACS), of the American Society of Agronomy. These same graduates also meet the requirements for registration with the Golf Course Superintendents Association of America. Urban Horticulture graduates are prepared to become certified arborists, certified horticulturists, or pesticide applicators.

Internships provide the opportunity for gaining valuable experience while earning credits toward a degree. Internships are arranged between the student, a faculty member and the cooperating professional employer. They may involve work experience with federal or state agencies or a variety of private, community or industrial agencies or firms. Teaching experience may also be gained through internships.

Enrollment goals are 150 students in the B.S. program and its various tracks (roughly 50 students in Urban Horticulture and 100 in Turfgrass Management).

Entomology Courses. Our courses are identified presently as entomology (ENT) or plant science (PLS). [We may drop this dichotomy if the departmental name is changed to include its entomological membership.] Our large enrollment entomology courses are ENT 385 (Introductory Entomology) and BIO/ENT286 (Humans, Insects, and Disease), a Gen. Ed. Course. Most of our ENT courses are graduate level and all will have 400/500 level designations to encourage undergraduate enrollment.

ENTOMOLOGY COURSES

(including instructor, credits, and students enrolled in recent offerings)

EVEN YEARS – FALL

ENT385	INTRODUCTORY ENTOMOLOGY	LEBRUN	3 CR 80 STUDENTS
ENT386	INTRO. ENTOMOLOGY LAB.	LEBRUN	1CR. 18 STUDENTS
ENT387	INSECTS OF TURF AND ORNAMENTALS	ALM	3 CR. 11 STUDENTS
ENT390	WILDLIFE AND HUMAN DISEASE	MATHER	3 CR. 21 STUDENTS
ENT561	AQUATIC ENTOMOLOGY	LOGAN	3 CR. 7 STUDENTS

EVEN YEARS - SPRING

BIO/ENT286	HUMANS, INSECTS, & DISEASE	LEBRUN	3 CR. 100 STUDENTS
ENT411/511	PESTICIDES AND THE ENVIRONMENT	ALM	3 CR. 19 STUDENTS
ENT519	INSECT BIOLOGICAL CONTROL	CASAGRANDE	3 CR. 8 STUDENTS
ENT533	GRAD. WRITING IN LIFE SCIENCES	LOGAN	3 CR. 12 STUDENTS

ODD YEARS – FALL

ENT385	INTRODUCTORY ENTOMOLOGY LEBRUN	3 CR	80 STUDENTS
ENT386	INTRO. ENTOMOLOGY LAB. LEBRUN	1 CR.	18 STUDENTS
ENT387	INSECTS OF TURF AND ORNAMENTALS ALM	3 CR.	11 STUDENTS
ENT390	WILDLIFE AND HUMAN DISEASE MATHER	3 CR.	21 STUDENTS
ENT544	INSECT ECOLOGY GINSBERG	2 CR.	7 STUDENTS
ENT550	INSECT TAXONOMY AND SYSTEMATICS ALM	3 CR.	9 STUDENTS

ODD YEARS – SPRING

BIO/ENT286	HUMANS, INSECTS, & DISEASE LEBRUN	3 CR.	100 STUDENTS
ENT411/511	PESTICIDES AND THE ENVIRONMENT ALM	3 CR.	19 STUDENTS
ENT 555	INSECT PEST MANAGEMENT CASAGRANDE	3 CR.	5 STUDENTS
ENT 571	INSECT MICROBIOLOGY LEBRUN	3 CR.	6 STUDENTS
ENT586	MEDICAL AND VETERINARY ENT. MATHER	3 CR.	4 STUDENTS

Changes from current offerings:
1) Aquatic Entomology moved from odd-year fall to even. (It will be taught again in F02)
2) All ENT 500-level courses will be changed to 400/500 to encourage additional undergrad enrollment.

Plant Science Courses - The following table represents early discussion among PLS faculty on a wide ranging revision of the Urban Horticulture and Turfgrass Management curriculum. Maynard will be spending quite a bit of time organizing department discussions on the revised curriculum in the spring of 2002, and will submit approved courses changes, additions and deletions to the CELS Curriculum Committee by May 2002. The following list of courses represents a reduction of *nineteen* 100 to 400-level courses (-37%), and the addition of four 500 to 600-level courses. This brings us more in line with the teaching FTEs remaining among our horticulture and plant pathology faculty (Englander, Maynard, Mitkowski, Ruemelle and Sullivan). Courses that are listed at the 100 to 400 level as "staff" will be rotated among faculty or represent experiential learning courses with multiple faculty sections. Courses listed as "new hire" are 400/500 level courses that have been identified as indispensable to the curriculum, and could only be taught a new hire, described elsewhere in this document. Three courses listed as taught by Gordon also have been identified as indispensable to the curriculum, and could be taught by one new half-time instructor position, if that were approved, or by a new faculty hire in traditional horticulture.

The largest enrollment PLS courses are PLS 150, PLS 200, PLS 306, PLS 322 and PLS 353/4. Positive changes in the horticulture curriculum are expected to attract many new students.

In order for the Department of Plant Sciences to teach a credible curriculum in turfgrass science and to adequately prepare students for vocations in turfgrass management, it is essential that our courses in turfgrass management (introductory and sports turfgrass), turfgrass pathology, turfgrass entomology, plant physiology, plant nutrition and weed science continue to be offered. The turfgrass science curriculum is an important

component of the Department's mission and students who receive training in this field are guaranteed employment, often before they reach graduation.

Efforts this spring (Maynard) also will bring PLS in line with the CELS Assessment and Portfolio Intiative. Many of the 400 and 500 level courses listed below reflect this move towards increased student-faculty interaction, peer mentoring among students, and development of portfolios as a part of the PLS educational experience.
Note: New or revised courses in *italics.*

Undergraduate Environmental Horticulture Courses:

Course (Code, Title, Cr)	**#**	**Instructor**	**Notes**
101, Freshman Inquiry into Insect and Plant Sciences, 1	2	Staff	Part of CELs 101 initiative.
150, Introduction to Horticulture, 3, N	52	Maynard	Gen Ed. Presently per course instruction.
*** Learning Community Section of PLS 150: Section 92 is a learning community section available to incoming freshman participants and transfer students, by override only.*			
190, Issues in Biotechnology, 3	14	Kauch	part of EBI?
200, Plant Protection, 4	36	Englander	
~~205, Horticultural Science, 3~~	~~21~~	~~Sullivan~~	~~Merge into PLS 150, section 92~~
210, Plant Protection Practicum, 1	15	Englander	
222, Ecology of the Home Landscape, 3	23	Casagrande, Maynard	
~~250, Plant Breeding and Genetics, 4~~	~~11~~	~~Ruemmele~~	replace with PLS 471?
255, Horticultural Plant Physiology, 3	17	Gordon / Jiang (instructor)	
301, Horticultural Plant Production, 4	14	Maynard	Merger of four current plant production courses
306, Landscape Management and Arboriculture, 3	25	Gordon (instructor)	New instruction to free up Maynard for PLS 150
320 Landscape Design, 3	13	Simeoni (LAR)	Presently per course instruction.
332, Intro. Plant Pathology, 4	30	Englander	Cross listed Bio
341, Introduction to Turfgrass Management, 3	12	Ruemelle	
350, Garden Plant Materials, 4	12	Gordon (instructor)	Replace interior plant courses, provides needed

			exposure to garden plants
353, Landscape Plant Materials, 4	28	Maynard	Presently taught by Simeoni (2 semesters)
361, Turfgrass Weed Identification, 1	8	Sullivan	Short course
362, Nursery and Landscape Weed Identification, 1		Sullivan	Short course
390, Irrigation Technology, 3	18	Sullivan	
395, Research Apprenticeship in Plant Sciences, 1-3		Staff	Formal laboratory apprenticeship.
399, Plant Sciences Internship (1-6)	15, 7	Staff	
401, 402 PLS and ENT Seminar, 1	20,21	Staff	
406, Senior Thesis in Insect and Plant Sciences, 3-6		Staff	
440, Diseases of Turfgrasses, Trees, Shrubs, and Ornamental Shrubs, 3	11	Mitkowski	
441, Plant Disease Laboratory, 1	11	Mitkowski	
442, Sports Turf Management, 3	16	Sullivan or Ruemmele	new focus
463, Principles of Plant Disease Control, 3		Mitkowski	
471, Plant Improvement, 4		Mitkowski	Replace PLS 250
475 (NRS 475), Plant Nutrition and Soil Fertility, 4	9	New Hire	
476, Environmental Plant Physiology, 3		*Maynard or New Hire*	
480, Bioengineering Practicum, 4	*10*	*New Hire*	*With Hybrigene LLC*
491, 492, Special Projects and Independent Study, 1-3	10, 17	Staff	
495, Advanced Insect and Plant Science Apprenticeship, 3		Staff	Formal laboratory apprenticeship, plus mentoring of PLS 395
497, Plant Sciences Cooperative Internship, 6-12		Staff	More time with industry or professional firms
498, Teaching Practicum in Insect and Plant Sciences, 1-3		Staff	Credit for teaching assistance
501, 502, Graduate Seminar in Plant Sciences, 1		Staff	
508, Seminar in Biological Literature, 3		Staff	
511, The Nature of Plant Disease, 3		Mitkowski	
512, Plant Growth and Development, 4		New Hire	
542, Sports Turf Management, 3		Sullivan	Grad. level of 442

563, Principles of Plant Disease Control, 3		Mitkowski	Graduate level of 463
571, Plant Improvement, 4		Mitkowski	Graduate level of 471
572, Plant Biochemistry, 3		New Hire	
575, Plant Nutrition and Soil Fertility, 4		New Hire	Graduate level of 475
576, Environmental Plant Physiology, 3		Maynard or New Hire	Graduate level of 476
591, 592, Nonthesis Research in Plant Sciences, 1-3		Staff	
EVS 599, Master's Thesis Research		Staff	
EVS 699, Doctoral Dissertation Research		Staff	

IV. THE PLAN.

A. Gap Analysis.

Existing Personnel:

We will pursue two changes in assignments of existing faculty:

1) We will strive to convert Dr. Alm from an Academic Year to a Calendar Year appointment. Steve's research and extension appointment require working throughout the summer, and he is presently the only faculty member in PLS on an Academic Year appointment who carries a sizable CE responsibility. Research funds formerly used to cover his summer salary will be freed to support his program.

2) Dr. Susan Gordon, Adjunct Assistant Instructor of Plant Sciences since 1996 has averaged 2-3 "per course" teaching assignments annually for the past 5 years. We wish to appoint her as a Lecturer in this department, to assure continuity in instructional effort and to provide her the benefits associated with this appointment.

It is of critical importance not to further reduce farm staffing. Attrition over the last decade has resulted in the unfortunate situation where highly trained research associates (and faculty) are undertaking day-to-day maintenance tasks. Retirement of these staff over the next five years should be linked to replacement of farm labor support and research support at the Research Assistant level. The department is in the unique position of supporting the major agricultural industries in Rhode Island, and fulfilling the primary missions of the Agricultural Experiment Station and Cooperative Extension. This responsibility to the agriculture infrastructure of Rhode Island warrants a certain level of staff support from AES, CE, and/or URI.

New Personnel:

Horticultural Biotechnology - A critical need exists for a new faculty position in horticulture. This position must fill instructional gaps and interface with efforts across the college in biotechnology, particularly efforts in bioengineering of pest resistant and/or non-invasive ornamental plants and turfgrasses. With increased instructional support, we are open to moving our best current teaching faculty into introductory/general education courses, which in turn will help attract more students into our horticulture and turfgrass management curricula. Several of our existing faculty members will work collaboratively with this horticultural biotechnologist, addressing needs of the Green Industry and focussing on development and invasive species issues. Particularly within the goals of the Sustainable Landscapes research and outreach programs, the potential exists for national recognition and excellent funding of research on pest resistance and/or non-invasiveness in plants.

Plant Stress Physiologist, Molecular Biologist - A tenure-track position is needed for a faculty member who will pursue vigorous, extramurally funded research in the physiology underlying abiotic and biotic stress tolerance in turfgrasses and other ornamental plants. Research is expected to become an integral part of a team effort studying plant genomics and plant improvement in grasses and woody ornamentals. Cooperative research with plant breeders, physiologists, plant pathologists and entomologists will be encouraged. Teaching will include two courses in horticultural and stress physiology and a graduate course in a subject of personal expertise.

Invasive Plant Ecology – A facultly position is needed to develop an innovative research and outreach program on invasive plant species with special emphasis on biological control strategies and integrated ecosystem management. Candidates should have a Ph.D. in weed science, plant ecology, horticulture or agronomy with a specialization in the ecology and control of invasive plant species. The position would interact with established programs in integrated pest management; coastal zone management, wildlife biology and horticulture. Teaching responsibilities would include advanced undergraduate courses in weed science, ecology of managed landscapes and a graduate course in the area of professional expertise. This position provides the opportunity to focus aspects of the integrated pest management and sustainable landscape interests of a number of faculty in our department, as well. This position is highly relevant to members of several other departments especially Natural Resources Science.

Greenhouse Support - The greenhouse range is central to all plant science, botany, biological control, and plant biotechnology efforts at URI. Critical concerns include the age and condition of the greenhouse range (addressed below) and the lack of staff support. As recently as 1995 there were three positions (a greenhouse manager and two laborers) assigned to the greenhouses. Now only one farmer position is responsible for both the Learning Landscape and the greenhouse range. The greenhouse range now includes a biotechnology greenhouse which must be managed to USDA/APHIS standards. This facility is seriously understaffed and requires an additional staff position and additional student labor at a minimum.

Vector-Borne Disease (VBD) Programs

Vector-borne disease activities at URI are supported within several departments of the College of the Environment and Life Sciences (CELS) but are principally centered in the Department of Insect and Plant Sciences (IPS) (Figure 2). Due to the multi-disciplinary nature of the VBD program, some of the current programmatic needs for achieving excellence in vector-borne disease research, training and outreach may be shared with other departments. The plan outlined below identifies the most critical needs as they relate to the core program in IPS. Specifically, we recommend:

1) Hiring 5 junior faculty/senior level research associates to provide specific expertise in climate modeling, extension, biotechnology, and insect immunology. These positions are needed to close critical gaps in scientific capacity for current and planned sponsored research, extension and student training. We envision a model where new hires are junior-level scientists that affiliate with senior PIs leading current programs for 33-67% time and effort, with remaining time and effort being available to other programs, core activities, or development of an independent research program. New hires could be Appendix F faculty with or without promises to convert the position to tenure track after 2-3 years. All new hires should qualify for inclusion in the NIH/COBRA grant program.

a. **Climate Modeling** - for the past 7 years, the Vector-Borne Disease program has been on the cutting edge of applying geographic information systems (GIS) technologies to the field of vector-borne disease. More recently, federal support has been increasing for initiatives related to 'Climate and Health'. In 1999, we hired a Ph.D. climatologist on grant and gift funds, to help build critical databases and develop proposals. Currently we have a very strong proposal pending review at NIH, however, the climatologist position is vacant, and the VBD program currently lacks dedicated on-site GIS expertise required to fulfill contracted work.

   Recommended Actions

   - Recruit a Ph.D. climatologist with strong modeling and GIS skills
   - Time & Effort assignment: 33% Climate & Vector-borne Disease Initiative, 33% State Climatologist (Extension), 33% teaching (3 credits/yr) and support of other CELS projects

b. **Tick Control Coordinator** – Rhode Island maintains an Office of Mosquito Abatement Coordination in the Division of Agriculture, Department of Environmental Management. There is no comparable tick abatement position dedicated to bridging research programs in the VBD program with local or state tick-borne disease needs. The most closely related program is led by Dr. Mather, who has conducted a statewide tick surveillance program continuously since 1993. However, this surveillance project has been without stable financial sponsorship since 2000, and there is no coordinated tick management response. Moreover, other initiatives

related to tick control have been *ad hoc* and largely un-coordinated. We envision an integrated applied research program on tick and mosquito population management and vector-borne disease suppression that have strong ties to the basic research programs in the VBD program.

Recommended Actions

- Integrate the DEM Office of Mosquito Abatement Coordination into RI Ag Exp Station and Cooperative Extension
- Recruit M.S. or Ph.D.-level scientist with extensive tick-borne disease research experience and an ability to supervise vector outreach programs
- Time & Effort assignment: 67% applied research, 33% outreach and education.
- Lobby state and federal sources to provide necessary funding to support tick-control coordination efforts in RI.

c. **Baculovirus Research** – Since 1994, a major initiative of the VBD program has been to develop novel vaccination strategies against tick-borne diseases. In 1999, this research adopted a genomics/proteomics approach to identifying immunogenic molecules. In so doing, more than 500 unique genes have been sequenced, many of which may be important for modulating host hemostasis. Many of these genes may express molecules with potent pharmacological properties. To capitalize on the potential intellectual property rights of these discoveries, our strategy will be to express recombinant proteins and to develop a partnership with the pharmaceutical industry in order to screen these 'natural products' for activity.

The rationale for developing an expertise specifically with baculovirus is that it has the potential for supporting two thrusts of the VBD program – vaccine development and invertebrate pathology research. Not only are baculoviruses the most popular eukaryotic vectors for high-level expression of foreign gene products, they also represent a group of DNA viruses known to be pathogenic for arthropods, multiplying prolifically in insect cells. Thus, in addition to supporting the vaccine development program, the person hired to head the baculovirus lab could contribute to the research and training mission of the invertebrate pathology program.

Recommended Actions

- Hire a Ph.D. molecular biologist with baculovirus experience
- Time & Effort assignment: 67% on NIH-sponsored tick vaccine project, 33 % on independent research and supporting invertebrate pathology studies.

d) **Molecular Diagnostics** – A current weakness of the VBD program is its inadequate expertise in molecular biology. Since 1996, we have attempted to address this weakness by hiring one post-doctoral scientist to develop and evaluate molecular diagnostic assays that support the tick- and mosquito-borne disease surveillance and research programs, and to purchase the basic equipment required to support such research. The incumbent in this position also assisted in training undergraduate and graduate students in basic molecular diagnostic assay procedures. This position has been vacant for the past year as additional funding has been sought.

Recommended Actions

- Hire a Ph.D. molecular biologist with experience appropriate to developing a state-of-the-art program to develop, evaluate and use modern molecular diagnostic assays
- Emphasis placed on developing assays to detect potential bioterrorism threats
- Time & Effort assignment: 33% mosquito and tick testing in support of statewide surveillance efforts, 33% on independent research leading to diagnostic "products", 33% teaching (3 credits/yr) and support of other projects in IPS or Microbiology

e) **Invertebrate Biochemist** – Biological control is a major thrust of the Invertebrate Pathology Laboratory but we lack critical expertise in arthropod immune systems. The incumbent in this position will work with arthropod vector species (ticks, mosquitoes) as part of a research team developing novel approaches to the management of vector-borne diseases. The appointee will be expected to develop an extramurally-funded research program, direct graduate students, and teach in the area of invertebrate physiology and biochemistry. A doctorate in an appropriate field is required, with experience in insect biochemistry. Knowledge of arthropod immunology is preferred. This position is critical to advance our current research program in arthropod pathology, especially research directions resulting from recent work that suggests novel modes of pathology by tick pathogens. This scientist would allow us to develop a cutting-edge research program that could lead to new ways to manage blood-feeding arthropods. Also, the expertise represented by this appointee would round out our entomology faculty, and provide instruction in insect physiology/biochemistry, a current gap in our graduate curriculum.

Recommended Actions

- Develop tenure-track position to develop an innovative research program on the biochemistry and physiology of arthropod immune mechanisms in response to pathogens.

2) Increasing the number of graduate student assistantships assigned directly to the vector-borne disease program. Ideally, each faculty would be assigned one CELS/AES assistantship (n=6-7). The graduate coordinator, in conjunction with each faculty program would use this assignment as a base for actively recruiting graduate students into the vector-borne disease program. This action is critical to the VBD Program goal of developing a trained public health workforce. It will also provide much-needed resources to increase research productivity.

3) Improving laboratory capacity, including: renovation of current laboratories in Woodward Hall, develop core facilities supporting molecular biology, build a mosquito insectary in Woodward Hall, and reassign additional laboratory and office space to completely meet the needs of current and new staff.

Recommended Actions

- Place high priority on developing plans to renovate Woodward 324 for Baculovirus Lab. $50,000 may be available from unspent research funds
- Develop aggressive development program for laboratory renovation
- Re-assign and renovate 2 labs and one office in Woodward basement for VBD program
- Build mosquito insectary space in currently unusable storage space in Woodward basement
- Install propane-powered generator at BL3 Containment facility
- Fund required maintenance contracts on BL3 Containment facility

4) Develop/expand web-based dissemination of VBD information.

Recommended Actions

- Task web-master to facilitate development of additional pages
- Hire consultants to set up interactive pages focusing on educational and research programs

Facility Needs:

Greenhouses - The URI greenhouse range includes greenhouses of various ages, but the newest of them is over 40 years old. They are in need of complete restoration and upgrade, including upgrade of the heating systems, venting and control systems, reglazing, capture of greenhouse runoff, classroom space and security. Biotechnology greenhouse space must meet federal APHIS standards. The growth chamber facility in the greenhouse building also has a number of chambers that need replacement.

Biological Control Laboratory - This facility needs extensive alterations to its HIVAC system. This project, which is currently under design, will cost about $50,000 to complete.

Vector-borne Disease Program - Upgrade facilities in Woodward as described above.

Equipment Needs:

Most departmental equipment needs are addressed through individual Hatch and grant requests. However, there is a growing need for the department to expand its use of digital materials in teaching and outreach programs. We need several digital cameras, laptop computers, and digital projectors. We could also greatly benefit from a digital image capture system and an image database web server. There is no capacity in CELS for measuring photosynthesis or chlorophyll fluorescence. A Licor LI-6400 system would be of great benefit to many of our programs, and would cost about $30,000 complete.

Program Coordination/Consolidations:

Agronomy/Turf/Peckham Farms - Consolidation of turf and agronomy farm operations and facilities at Peckham Farm should not proceed without careful planning. We need to maintain the research and educational capabilities that are now available through these facilities including field space for turf research, plantings for biological control research, and space for field evaluations of new products from our biotechnology initiative. This field facility must be secure, under irrigation, and large enough to allow isolation of various experiments that involve mobile insects and spores. The facility must be coupled with space for classrooms, laboratories, offices, and storage and maintenance of farm equipment. The design of such a facility is beyond the capabilities of our current departmental faculty and staff. If URI wants us to move from current facilities, we will work with a URI-funded architect to design a facility to meet our needs and schedule a transition. However, we seriously question whether the resources are available for the design, let alone the construction and transition to a new facility.

East Farm - The department is very active at the East Farm. Major evaluation trials and long term projects are underway. At East Farm there are good teaching and research facilities, and the best functioning greenhouse range on campus. The RI Wild Plant Society and Master Gardeners Association utilize greenhouse space in the ornamentals complex. East Farm is a high-visibility, highly-utilized facility worthy of institutional support. Discussions on how to more fully utilize East Farm to the benefit of the industry and public are welcomed. There is a chronic need for additional labor for mowing and maintenance of plantings. This need could be addressed through additional support for the greenhouse and Learning Landscape, freeing labor for use at this farm.

URI Diagnostics - Our department is involved in a number of diagnostic activities including the Plant Protection Clinic, the Tick Lab, Turf Diagnostic Lab, and Master Gardener Hotline. Now, it appears that the DEM Mosquito Abatement program, formerly in Wakefield's Government Center, will shortly move on campus. This move

will enhance collaborative efforts between the department and the state's mosquito program and it will also bring the tick lab and the mosquito abatement program in close physical proximity. We would like to develop an umbrella organization (tentatively called URI Diagnostics) to serve as a "one stop" center serving all the state's arthropod and plant diagnostic needs. This center, which will be closely linked with the CE Center, might be administered by a professional staff member who, with secretarial assistance, would make immediate determinations (with recommendations) or get samples to the proper specialty group (Plant Protection Clinic, turf pathogen program, etc.) The center will administer fees and see that all clients get appropriate responses. The center could operate as a "cost center", generating some revenue, but would need (at least initial) support from CE (and possibly DEM).

B. Timeline

General

- All proposed curriculum changes will be initiated during the spring of 2002.
- Issues related to existing personnel (Alm, Gordon) should be resolved in 2002, but require additional funding.

Sustainable Landscapes

- Horticulture faculty and greenhouse support positions are the most immediate priorities.
- Followed by positions in Plant Physiology and Ecology of Invasive Species.

Vector-Borne Disease Program

- Partial funding available immediately for **Baculovirus** position. $38,000 + benefits budgeted for 3-5 yr. Possible applicant identified (Lulin Li). Suggested salary for new Appendix F Assistant Professor in molecular biology = $52,000 (9 mo)
- Partial funding available immediately for **Climate Modeling** position. $10,000 in Hatch project (3 yrs), $10,000 in Partnership account (1 yr), $10,000 in Foundation account (1 yr). Suggested salary for new Appendix F Assistant Professor in Climatology = $45,000 (9 mo). NIH grant proposal pending review (by 3/02) has budgeted $37,500 + benefits for this position.
- Possible partial funding available for tick control coordinator position as part of USDA/ARS Northeast Tick Control Project. Meeting 1/24/02 to make decisions regarding establishment of 1-2 regional tick control demonstration projects. We have a strong proposal prepared. Could lobby Senator Reed to attach additional funds to the ARS appropriation in support of RI demonstration project. If funded, would fully support **Tick Control Coordinator** position.
- URI will begin housing DEM Mosquito Abatement Coordination in Spring, 2002. One favorable discussion held (9/18/01) with DEM Director regarding Vector-

borne Disease re-organization. Governor established Commission to study Lyme disease needs (Fall, 2001)—may be relevant but no meeting yet.

- $50,000 expected to be available for Woodward 324 (Baculovirus Lab) renovation in April 2002.
- All other proposed activities require the development of new funds. Partial funding for **Molecular Diagnostic** position planned for NIH grant submission 6/01/02.
- COBRA RFP response due February 2003.
- Re-assign office space in Woodward basement (Rm 3 and 3A) in Spring 2002, to coincide with funded lab renovation in Woodward 011, 002, 002A and 002B.