# 2007 West Virginia State University Research Annual Report

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2007 West Virginia State University Research Annual Report

## I. Report Overview

### 1. Executive Summary

West Virginia State University (WVSU) became fully reinstated as an 1890 Land-Grant Institution in November of 2001 and began the reactivation of its research programs immediately thereafter. "The Gus R. Douglass Land-Grant Institute" is the arm of the University in charge of the research and extension activities. The mission of the Institute remains that of delivering the institution's land-grant mission related to the dissemination of research, teaching, and extension services to the state's citizens. In Fiscal Year 2007, the University continued its quest to rebuilt capacity for its land-grant research portfolio.Federal Formula and its corresponding matching funds, as well as other competitive and uncompetitive federal, state, and local support were also the sources of funding for research activities at the University. Although modest, the University experienced growth in terms of research programming, personnel, and research capacity in 2007.Faculty, students and staff were involved in the completion of those goals and objectives set forth the 2007 activities cycle.As research programs mature, some of its associated projects have started producing yields in terms of data and publications.New programs have been incorporated in 2008 and some other programs have been eliminated due to the lack of performance.The present report provides a detail analysis in relation to the accomplishments for each planned program and corresponding projects.

It is important to note that in terms of Scientific Years (SY), during previous years, our program wrongly considered all the support of staff participating in research activities; however we have adjusted this number to only reflect those researchers with a doctorate level or equivalent experience.This has resulted in a dramatic change in SY reported for this year and years thereafter.

**Total Actual Amount of professional FTEs/SYs for this State**

| Year:2007 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 0.0 | 0.0 | 0.0 | 15.3 |
| Actual | 0.0 | 0.0 | 0.0 | 8.1 |

## II. Merit Review Process

### 1. The Merit Review Process that was Employed for this year

- Combined External and Internal University External Non-University Panel

### 2. Brief Explanation

Each year, during the months of April and May, all research programs were subjected to a review process. The process included an internal and external evaluation. An oral presentation at the WVSC Annual Research Symposium was a key component of the overall annual evaluation and it was required for land-grant sponsored researchers. Stakeholders identified by the procedures outlined below were invited to the Symposium. The internal evaluation consisted of an Office and/or Departmental appraisal by the executive staff. Additionally, all participants in land-grant sponsored research critically assessed the research of fellow colleagues for developmental purposes.

A research advisory panel conducted the external program evaluations. The research advisory panel consisted of local scientists with a wide variety of backgrounds, business leaders and other community members considered as suitable stakeholders for research programs. The evaluations from these panels were utilized to help rank and allocate funds to specific land-grant programs. Evaluation assessing research productivity versus resources spent was included in the ranking of continuing projects to facilitate funding decisions during the 2008 budget year or cycle.

## III. Stakeholder Input

### 1. Actions taken to seek stakeholder input that encouraged their participation

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals

**Brief Explanation**

Potential stakeholders were identified and invited to participate on a review panel to evaluate the land-grant research programs at the University.The invitation stressed the importance and requirement of our programs to have an input review processed by a diverse stakeholder group.Research administrators and research scientists sought individuals and groups within a specific area of expertise or understanding to provide input and guide the direction of the research programs in order to better address the needs of those individuals or groups.Several collaborations have been formed as a result of these activities.Traditional stakeholder groups include industry, departments of agriculture, and individual farmers.Non-traditional groups include non-profit environmental organizations, alternative energy groups and cooperatives, and under-served landowners who have been impacted by mineral extraction.

**2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them**

**1. Method to identify individuals and groups**

- Use Advisory Committees
- Other (Researcher Interactions)

**Brief Explanation**

As mentioned previously, research administrators and research scientists sought individuals and groups within a specific area of expertise or understanding to provide input and guide the direction of the research programs in order to better address the needs of those individuals or groups.These individuals were invited directly to participate in this endeavor through a written invitation.Other individuals were also encouraged by previous members or other University staff. Thus, the research advisory committee consisted of several individuals representing the different areas addressed by the programs.Target areas defined based on the research portfolio at the Institution.Within each target area (e.g. farm owners, government agencies, industry, etc.) individuals were identified and invited to participate.These individuals advised the scientists on possible stakeholders and issues important to those stakeholders.The individual research scientists, attended professional seminars, special interest meetings and other relevant conferences, have identified stakeholders through interactions with groups or individuals interested in the research.

**2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them**

**1. Methods for collecting Stakeholder Input**

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting specifically with non-traditional groups

**Brief Explanation**

Inputs in writing were collected during the research advisory review through a specific survey handed before and during the meeting. Also minutes in relation to discussions with the committee participants were collected, analyzed and used to guide the programming process of the following research activity cycle.

**3. A statement of how the input was considered**

- To Identify Emerging Issues
- Redirect Research Programs
- In the Staff Hiring Process
- To Set Priorities

**Brief Explanation**

All inputs received and collected in writing from the research advisory committee were used to guide the programming process of the following research activity cycle.It is common that these inputs have an effect on the distribution of efforts or overall share (in relation to our plan of work).Rarely these inputs have resulted in the total elimination of a planned program.

**Brief Explanation of what you learned from your Stakeholders**

Through the stakelholder input we learned that some research projects/areas needed to be reinforced in terms of resource support as they were perccieved as criticaly important by stakeholder committee members.

## IV. Expenditure Summary

**1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)**

| Extension | | Research | |
|---|---|---|---|
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 0 | 0 | 0 | 1177351 |

**2. Totaled Actual dollars from Planned Programs Inputs**

| | Extension | | Research | |
|---|---|---|---|---|
| | Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| Actual Formula | 0 | 0 | 0 | 1143216 |
| Actual Matching | 0 | 0 | 0 | 803064 |
| Actual All Other | 0 | 0 | 0 | 763177 |
| Total Actual Expended | 0 | 0 | 0 | 2709457 |

**3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous years**

| | | | | |
|---|---|---|---|---|
| Carryover | 0 | 0 | 0 | 430795 |

## V. Planned Program Table of Content

| S. NO. | PROGRAM NAME |
|---|---|
| 1 | Natural Resource Management |
| 2 | Aquaculture |
| 3 | Environmental Microbiology |
| 4 | Plant Genomics |
| 5 | Agricultural Biotechnology |
| 6 | Alternative Agriculture |

**Program #1**

## V(A). Planned Program (Summary)

**1. Name of the Planned Program**

Natural Resource Management

## V(B). Program Knowledge Area(s)

**1. Program Knowledge Areas and Percentage**

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 133 | Pollution Prevention and Mitigation | | | | 100% |
| | **Total** | | | | 100% |

## V(C). Planned Program (Inputs)

**1. Actual amount of professional FTE/SYs expended this Program**

| Year: 2007 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 0.0 | 0.0 | 0.0 | 2.5 |
| Actual | 0.0 | 0.0 | 0.0 | 1.5 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 0 | 0 | 0 | 190536 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 0 | 0 | 0 | 133844 |
| 1862 All Other | 1890 All Other | 1862 All Other | 1890 All Other |
| 0 | 0 | 0 | 18775 |

## V(D). Planned Program (Activity)

**1. Brief description of the Activity**

- Conduct research experiments - Present and/or publish the results

**2. Brief description of the target audience**

- Watershed groups - Mine operators - Power generation utilities - Chemical manufacturers - Environmental regulators

## V(E). Planned Program (Outputs)

### 1. Standard output measures

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

| | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| Year | Target | Target | Target | Target |
| Plan | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 |

### 2. Number of Patent Applications Submitted (Standard Research Output)

**Patent Applications Submitted**

| Year | Target |
|---|---|
| Plan: | 0 |
| 2007 : | 0 |

**Patents listed**

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| | Extension | Research | Total |
|---|---|---|---|
| Plan | | | |
| 2007 | 0 | 0 | 0 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- Scientific presentations and publications

| Year | Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

## V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O No. | OUTCOME NAME |
|---|---|
| 1 | Increased awareness among power generators of carbon sequestration technology (#) |
| 2 | Increased awareness of water remediation technology among stakholders (%) |
| 3 | Development of novel types of environmental remediation (#) |
| 4 | Increased sequestration of carbon dioxide in WV (%) |
| 5 | Reduced cost of metal remediation in water (%) |

**Outcome #1**

**1. Outcome Measures**

Increased awareness among power generators of carbon sequestration technology (#)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 1 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |

**Outcome #2**

**1. Outcome Measures**

Increased awareness of water remediation technology among stakholders (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 5 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |

**Outcome #3**

**1. Outcome Measures**

Development of novel types of environmental remediation (#)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |

**Outcome #4**

**1. Outcome Measures**

Increased sequestration of carbon dioxide in WV (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |

**Outcome #5**

**1. Outcome Measures**

Reduced cost of metal remediation in water (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**

- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities

**Brief Explanation**

## V(I). Planned Program (Evaluation Studies and Data Collection)

**1. Evaluation Studies Planned**

- Retrospective (post program)
- During (during program)

**Evaluation Results**

This program has been significantly modified. The two previous major projects were eliminated from the plan of work due to lack of acceptabl performance by scientists.One new program has been incorporated into this area.

**Key Items of Evaluation**

This program has been significantly modified. The two previous major projects were eliminated from the plan of work due to lack of acceptabl performance by scientists.One new program has been incorporated into this area.

**Program #2**

## V(A). Planned Program (Summary)

**1. Name of the Planned Program**

Aquaculture

## V(B). Program Knowledge Area(s)

**1. Program Knowledge Areas and Percentage**

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 302 | Nutrient Utilization in Animals | | | | 80% |
| 307 | Animal Management Systems | | | | 15% |
| 403 | Waste Disposal, Recycling, and Reuse | | | | 5% |
| | **Total** | | | | 100% |

## V(C). Planned Program (Inputs)

**1. Actual amount of professional FTE/SYs expended this Program**

| Year: 2007 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 0.0 | 0.0 | 0.0 | 1.7 |
| Actual | 0.0 | 0.0 | 0.0 | 1.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 0 | 0 | 0 | 190536 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 0 | 0 | 0 | 133844 |
| 1862 All Other | 1890 All Other | 1862 All Other | 1890 All Other |
| 0 | 0 | 0 | 131518 |

## V(D). Planned Program (Activity)

**1. Brief description of the Activity**

- Conduct research experiments - Present and/or publish research results

**2. Brief description of the target audience**

•Fish Farmers •Aquaculture industry (feeds suppliers) •Government Regulatory Agencies

## V(E). Planned Program (Outputs)

### 1. Standard output measures

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

| | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| Year | Target | Target | Target | Target |
| Plan | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 |

### 2. Number of Patent Applications Submitted (Standard Research Output)

**Patent Applications Submitted**

| Year | Target |
|---|---|
| Plan: | 0 |
| 2007 : | 0 |

**Patents listed**

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| | Extension | Research | Total |
|---|---|---|---|
| Plan | | | |
| 2007 | 0 | 0 | 0 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- Presentations and/or publications

| Year | Target | Actual |
|---|---|---|
| 2007 | 1 | 1 |

**Output #2**

**Output Measure**

- Active Participation in the West Virginia Aquaculture Forum (Jan 2007)

| Year | Target | Actual |
|---|---|---|
| 2007 | {No Data Entered} | 1 |

## V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O No. | OUTCOME NAME |
|---|---|
| 1 | Lower feed costs (%) |
| 2 | Reduce nitrogen and phosphorus in discharge water (%) |
| 3 | Increased profitability of aquaculture operations (%) |

**Outcome #1**

**1. Outcome Measures**

Lower feed costs (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Lowering feed cost is important to both, fish farmers and fish feed manufacturers.

**What has been done**

Research is currently being conducted in relation to lowering the feed cost via replacement of fish meal protein with proteins derived from digested poutry waste.

**Results**

Data are currently being analyzed.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 302 | Nutrient Utilization in Animals |
| 307 | Animal Management Systems |
| 403 | Waste Disposal, Recycling, and Reuse |

**Outcome #2**

**1. Outcome Measures**

Reduce nitrogen and phosphorus in discharge water (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Lowering the amount of nitrogen and phosphorous in discharged water will lower production operational costs associated with water treatment by fish producers.

**What has been done**

Trials are being conducted at this time.

**Results**

Data will become avaiable after feeding trials and analyses.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 403 | Waste Disposal, Recycling, and Reuse |
| 307 | Animal Management Systems |
| 302 | Nutrient Utilization in Animals |

**Outcome #3**

**1. Outcome Measures**

Increased profitability of aquaculture operations (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Lowering fish diet costs and reducing aquaculture wastes are important factors to fish farmers and government regulators.

**What has been done**

Protein replacement experiments have been completed and data analyses are currently taking place.

**Results**

Results will be available after completion of data analyses.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 302 | Nutrient Utilization in Animals |
| 403 | Waste Disposal, Recycling, and Reuse |
| 307 | Animal Management Systems |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**

- Economy
- Government Regulations

**Brief Explanation**

## V(I). Planned Program (Evaluation Studies and Data Collection)

**1. Evaluation Studies Planned**

- Retrospective (post program)
- During (during program)

**Evaluation Results**

**Key Items of Evaluation**

**Program #3**

## V(A). Planned Program (Summary)

**1. Name of the Planned Program**

Environmental Microbiology

## V(B). Program Knowledge Area(s)

**1. Program Knowledge Areas and Percentage**

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 403 | Waste Disposal, Recycling, and Reuse | | | | 100% |
| | Total | | | | 100% |

## V(C). Planned Program (Inputs)

**1. Actual amount of professional FTE/SYs expended this Program**

| Year: 2007 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 0.0 | 0.0 | 0.0 | 3.1 |
| Actual | 0.0 | 0.0 | 0.0 | 2.1 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 0 | 0 | 0 | 190536 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 0 | 0 | 0 | 133844 |
| 1862 All Other | 1890 All Other | 1862 All Other | 1890 All Other |
| 0 | 0 | 0 | 246339 |

## V(D). Planned Program (Activity)

**1. Brief description of the Activity**

The program of research is focused on the microbial ecology of thermophilic anaerobic digestion.West Virginia State University operates a pilot plant thermophilic anaerobic digester facility that consists of a 10,000 gallon continuous stir tank reactor located on the campus.The digester is operated at 55C and has been fed and stabilized on poultry litter for several years.In addition, the operation and sampling of a 15 liter thermophilic biofilm digester was continued.Three principal projects were advanced during 2007: culture-independent molecular characterization of the digester microbial community, analysis of the long-term stability of the pilot plant digester, and identification of digester populations with specific metabolisms.

A major goal of 2007 was to further expand a comprehensive collection of bacterial and archaeal 16S rDNA clones from a pilot plant thermophilic digester and a derived biofilm digester.The analysis of 16S rDNA libraries from the pilot plant and biofilm digesters progressed, including statistical analysis of the diversity.The diversity of the methanogenesis operon gene mcrA was sampled in the biofilm digester via cloning.The analysis to date has shown that the biofilm and pilot plant digesters contain similar, but distinct, microbial communities.The biofilm community contains significantly more biodiversity than the suspended community.The Chao 1 diversity estimator projects that the biofilm contains a minimum of 320 operational taxonomic units (OTUs) at the 97% similarity level, while the pilot plant contains a minimum of 180 OTUs.The structure of the pilot plant community in terms of taxon rank-abundance shows few OTUs of high abundance and most OTUs of low abundance.Approximately 85% of the clones in the pilot plant fall into the Firmicutes with 35% of these being Clostridia and 40% being unclassified.The majority of the Clostridia cannot be classified more specifically than family with the RDP.This demonstrated a large percentage of novel bacterial diversity in the WVSU thermophilic digesters.

Another important unanswered question is the relationship between the stability of the performance of digesters over time and the stability of the diverse microbial populations within the digester.Analysis of the long-term stability of microbial populations in an active, stable digester was also begun.Several samples were collected from the WVSU thermophilic digester during the preceding three years.Analysis of these samples was begun by creating clone libraries of the 16S rRNA genes from the bacteria.Experiments were conducted to identify key populations involved in fatty acid oxidation in the WVSU thermophilic digester.Stable isotope probing using 13C-labeled propionic acid was used to label populations derived from a 15 liter biofilm digester.13C-labeled and unlabeled DNAs were isolated and analyzed using terminal restriction fragment length polymorphism (T-RFLP) analysis.

**2. Brief description of the target audience**

This research is expected to impact a broad audience.The primary target audience will be research scientists and environmental engineers who work with anaerobic digestion and, more broadly, environmental biotechnology.Undergraduate and graduate students will also be impacted through the principal investigators teaching and research laboratory at West Virginia State University.In addition, anaerobic digester operators, livestock producers and the poultry industry will be benefited as the processes of anaerobic digestion are better understood and knowledge is disseminated.

The primary audience who benefited from this research in 2007 was students at WVSU.A PhD student and two undergraduate students worked directly on this research and learned microbiology and molecular biology methods.The knowledge acquired by the PI through the analysis of this data was directly transferred to the topics of environmental biotechnology and environmental genomics which he presented in his classes: General Microbiology and Environmental Microbiology.During 2007, the PI provided consultation to engineers working on designing thermophilic digesters in Pennsylvania.The PI also provided consultation to MATRIC (Mid-Atlantic Technology, Research and Innovation Center) concerning the design of anaerobic digesters. The PI also maintained collaborations with Dr. Teodoro Espinosa-Solares (University of Chapingo, Mexico) and Dr. David Stafford (Enviro Control Ltd, Monmouth, England) concerning anaerobic digester engineering and microbiology.

## V(E). Planned Program (Outputs)

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

| | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Year** | **Target** | **Target** | **Target** | **Target** |
| **Plan** | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 |

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

| Year | Target |
|---|---|
| **Plan:** | 0 |
| 2007 : | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| | Extension | Research | Total |
|---|---|---|---|
| **Plan** | | | |
| 2007 | 0 | 0 | 0 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- Scientific publications and/or presentations

| Year | Target | Actual |
|---|---|---|
| 2007 | 2 | 0 |

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O No. | OUTCOME NAME |
|---|---|
| 1 | Increase knowledge of anaerobic bacteria (%) |
| 2 | Identify antibiotic resistant bacteria in poultry manure (#) |
| 3 | Increase digester efficiency (%) |

**Outcome #1**

**1. Outcome Measures**

Increase knowledge of anaerobic bacteria (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 10 | 50 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

The target audience of this research is microbiologists, engineers and environmental biotechnologists who work on anaerobic digestion, as well as undergraduate and graduate students, anaerobic digester operators, and livestock and poultry farmers.

**What has been done**

The program of research was focused on the microbial ecology of thermophilic anaerobic digestion. West Virginia State University operates a thermophilic anaerobic digester facility, including a 10,000 gallon pilot plant and laboratory-scale reactors. Three principal projects were advanced: culture-independent molecular characterization of the digester microbial community, analysis of the long-term stability of the microbial populations in the pilot plant digester, and identification of digester populations that metabolize fatty acids.

**Results**

A major goal of 2007 was to further expand a comprehensive collection of bacterial and archaeal 16S rDNA clones from a pilot plant thermophilic digester and a derived biofilm digester. The biofilm community was found to contain significantly more biodiversity than the suspended cell community. The Chao 1 diversity estimator projects that the biofilm contains a minimum of 320 operational taxonomic units (OTUs) at the 97% similarity level, while the pilot plant contains a minimum of 180 OTUs. The structure of the pilot plant community in terms of taxon rank-abundance shows few OTUs of high abundance and most OTUs of low abundance. Approximately 85% of the clones in the pilot plant fall into the Firmicutes with 35% of these being Clostridia and 40% being unclassified. This demonstrates a large percentage of novel bacterial diversity in the WVSU thermophilic digesters. Stable isotope probing using 13C-labeled propionic acid was used to label populations derived from a 15 liter biofilm digester. 13C-labeled and unlabeled DNAs have been isolated and analyzed using T-RFLP analysis.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 403 | Waste Disposal, Recycling, and Reuse |

**Outcome #2**

**1. Outcome Measures**

Identify antibiotic resistant bacteria in poultry manure (#)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**
Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

No activities were conducted to be measured on this section as it was the case in the previous year (2006).

**What has been done**

**Results**

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 403 | Waste Disposal, Recycling, and Reuse |

**Outcome #3**

**1. Outcome Measures**
Increase digester efficiency (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**
Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 5 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

The target audience of this research is microbiologists and engineers who work on anaerobic digestion as well as other environmental biotechnologists interested in biomass-to-bioenergy production. In addition, anaerobic digester operators and livestock and poultry farmers will benefit.

**What has been done**

The program of research was focused on the microbial ecology of thermophilic anaerobic digestion. West Virginia State University operates a thermophilic anaerobic digester facility, including a 10,000 gallon pilot plant which digests poultry litter and laboratory-scale reactors. This research seeks to explain the exceptional performance of the WVSU digester in terms of microbial diversity and ecology.

**Results**

The WVSU pilot plant digester has performed exceptionally well for several years in treating poultry litter. Research examining the long-term stability of the WVSU thermophilic digester in terms of the stability and diversity of bacterial populations was begun during 2007. Samples had been previously collected from the digester while treating poultry litter over a four year period of time. During 2007 the analysis of these samples was begun by creating 16S rDNA clone libraries of the bacteria from three samples. More than 600 clones have been collected and about one third of these samples have been sequenced. The analysis of the phylogenetic diversity and abundance of these sequences is being used to define the stability of the digester microbial community over time.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 403 | Waste Disposal, Recycling, and Reuse |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**

- Economy
- Government Regulations

**Brief Explanation**

The country and world's economy as well as government regulation still factor that might affect the outcomes of this research.However in 2007 these two external factors did not significantly contribute or affected the outcome of this research.

## V(I). Planned Program (Evaluation Studies and Data Collection)

**1. Evaluation Studies Planned**

- Retrospective (post program)
- Before-After (before and after program)

**Evaluation Results**

**Key Items of Evaluation**

**Program #4**

## V(A). Planned Program (Summary)

**1. Name of the Planned Program**

Plant Genomics

## V(B). Program Knowledge Area(s)

**1. Program Knowledge Areas and Percentage**

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 201 | Plant Genome, Genetics, and Genetic Mechanisms | | | | 50% |
| 202 | Plant Genetic Resources | | | | 35% |
| 204 | Plant Product Quality and Utility (Preharvest) | | | | 15% |
| | **Total** | | | | 100% |

## V(C). Planned Program (Inputs)

**1. Actual amount of professional FTE/SYs expended this Program**

| Year: 2007 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 0.0 | 0.0 | 0.0 | 5.2 |
| Actual | 0.0 | 0.0 | 0.0 | 2.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 0 | 0 | 0 | 190536 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 0 | 0 | 0 | 133844 |
| 1862 All Other | 1890 All Other | 1862 All Other | 1890 All Other |
| 0 | 0 | 0 | 240158 |

## V(D). Planned Program (Activity)

**1. Brief description of the Activity**

There are three research projects in progress under this research program. These projects include: (1) development and characterization of molecular markers for genetic improvement of pepper and watermelon, (2) mapping biomass QTLs for Arabidopsis, and (3) greenhouse tomato breeding project. The pepper and watermelon research focuses on mapping fruit quality and yield related traits using DNA marker technology. Molecular markers like AFLP, SNP and SSR markers have been developed for marker assisted selection in pepper and watermelon .Genetic mapping of F2 populations using these markers is in progress.Sixty microsatellites and 20 AFLP primer combinations are being used to estimate the molecular diversity among cultivated pepper species namely Capsicum annuum, Capsicum bacatum, Capsicum pubescence, Capsicum frutescence and Capsicum chinense. We identified 1155 polymorphic markers that are used for phylogenic analysis and principle component analysis. Results indicated that molecular markers could clearly differentiate different species specific clades in the tree diagram that is drawn from genetic distances estimated from UPGMA analysis. Two F2 crosses (Capsicum frutescence X Capsicum annuum and Capsicum bacatum X Capsicum bacatum) are selected as they are developed involving promising accessions from our previous germplasm evaluations.

As the genetic diversity in cultivated watermelon (Citrullus lanatus var. lanatus) is not very high, 31 watermelon Plant Introductions collected from diverse geographical locations and representing major groups of Citrullus species are selected to understand the molecular diversity using AFLP and SSR polymorphisms.AFLP markers showed high polymorphism (3098 polymorphic bands) and the SSR markers produced 294 polymorphisms among the watermelon germplasm collections. Based on the diversity data, crosses were made among the diverse accessions from two different subspecies (Citrullus lanatus var. lanatus and Citrullus lanatus var. citroides). The F1 seed has been collected from these crosses for field evaluation and to develop interspecific F2 population for genetic mapping and to select segregants for various fruit traits, more female flowers and disease resistance.

A recombinant inbred population of Arabidopsis (Columbia X Landsberg erecta) consisting 100 progenies was grown in three replications under controlled growth conditions. We recorded several traits that are related to growth and hence contributing to the total biomass accumulation. We identified several QTLs using the maps that are previously published with genome wide markers in this cross. Several QTLs that are highly significant were identified. Currently we are recording the data of all the traits in 96 different ecotypes that are collected from all over the world.

Tomato germplasm and experimental hybrids were evaluated for plant and fruit quality traits under greenhouse conditions.Promising hybrids were advanced and additional crosses were made.Seed from these fruit were extracted and inventoried.DNA from germplasm and promising hybrids were extracted and quantified for use in PCR-based marker systems and AFLP analysis.Data on fruit quality was summarized and presented at research meetings along with preliminary marker and AFLP analysis.

**2. Brief description of the target audience**

- Germplasm Collectors/Curators
- Plant Breeders
- Plant Pathologist/Entomologists
- Horticulturalists/Agronomists
- Seed Companies
- Growers/Farmers
- Extension Agents
- Plant Geneticists

## V(E). Planned Program (Outputs)

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

| | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Year** | **Target** | **Target** | **Target** | **Target** |
| **Plan** | 0 | 0 | 0 | 0 |
| 2007 | 20 | 15 | 50 | 0 |

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

| Year | Target |
|---|---|
| **Plan:** | 0 |
| 2007 : | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| | Extension | Research | Total |
|---|---|---|---|
| **Plan** | | | |
| 2007 | 0 | 2 | 0 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- Scientific publications and/or presentations

| Year | Target | Actual |
|---|---|---|
| 2007 | 2 | 7 |

## V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O No. | OUTCOME NAME |
|---|---|
| 1 | Increase profitability of hydroponic tomatoes (%) |
| 2 | Gene map for vegetable crops (#) |

**Outcome #1**

**1. Outcome Measures**

Increase profitability of hydroponic tomatoes (%)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

As of 2005 the greenhouse tomato industry in North America accounted for 37% of fresh tomato sales compared to 10% in 1999. However, most greenhouse tomato varieties are bred for European conditions and consumers. Coupled with the rapid growth in production in North America has been a decline in prices, which challenges growers to be profitable by offering a better quality product at lower production costs. One solution is development of new varieties adapted to North American conditions, our consumers needs and with high priority traits such as disease and pest resistance.

**What has been done**

We are evaluating germplasm for desirable traits and enhancing existing cultivars by transferring these traits to develop new cultivars for the greenhouse tomato industry with resistance to insects and diseases and better organoleptic traits to meet the needs of the North American producer.

**Results**

Our research supports the need to develop greenhouse tomato indeterminant lines, as field tomato indeterminant lines do not perform as well in tomatoes developed specifically for the greenhouse environment. PCR based markers assessed at this time show little diversity among the lines used in the breeding program, thus additional markers and marker systems will need to be utilized.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 202 | Plant Genetic Resources |
| 201 | Plant Genome, Genetics, and Genetic Mechanisms |
| 204 | Plant Product Quality and Utility (Preharvest) |

**Outcome #2**

**1. Outcome Measures**

Gene map for vegetable crops (#)

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

a. Identified fruit related QTLs from two diverse populations of pepper
b. Generated 50SSRs, 250 AFLPs and 567 SNPs (from clones of AFLPs) that shows up differences in pepper accessions.
c. Performed diversity analysis in watermelon cultivated and wild taxa and related US watermelons to the North African types.
d. Identified melon fruit related QTLs from an Ukrainian mapping population
e. Identified 26 QTLs that are responsible for plant growth that contributes to the overall biomass.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 204 | Plant Product Quality and Utility (Preharvest) |
| 201 | Plant Genome, Genetics, and Genetic Mechanisms |
| 202 | Plant Genetic Resources |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**

- Natural Disasters (drought,weather extremes,etc.)
- Economy

**Brief Explanation**

Physical facilities not adequate (laboratory, greenhouse and fields).

## V(I). Planned Program (Evaluation Studies and Data Collection)

**1. Evaluation Studies Planned**

- Retrospective (post program)

**Evaluation Results**

**Key Items of Evaluation**

**Program #5**

## V(A). Planned Program (Summary)

**1. Name of the Planned Program**

Agricultural Biotechnology

## V(B). Program Knowledge Area(s)

**1. Program Knowledge Areas and Percentage**

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 206 | Basic Plant Biology | | | | 100% |
| | Total | | | | 100% |

## V(C). Planned Program (Inputs)

**1. Actual amount of professional FTE/SYs expended this Program**

| Year: 2007 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 0.0 | 0.0 | 0.0 | 1.8 |
| Actual | 0.0 | 0.0 | 0.0 | 1.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 0 | 0 | 0 | 190536 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 0 | 0 | 0 | 133844 |
| 1862 All Other | 1890 All Other | 1862 All Other | 1890 All Other |
| 0 | 0 | 0 | 49177 |

## V(D). Planned Program (Activity)

**1. Brief description of the Activity**

The initial studies are focused on Tryptophan monooxygenase (TMO) from Agrobacterium tumefaciens. The objectives of this research proposal on "Structural and Mechanistic studies of Tryptophan monooxygenase from A. tumefaciens" are to characterize the TMO enzyme from Agrobacterium tumefaciens. It is a plant pathogenic organism responsible for the crown gall disease in the plants, results in compromised growth and results in decrease in the agricultural yield.None of the basic enzyme parameters like substrate affinity constants or reactions rates for the TMO of A. tumefaciens have so far been established. And also no structural information of any TMO is yet available. Because of its role in the tumorigenesis in plant, the regulation of IAA synthesis is of interest. Studies on the structure and catalytic mechanisms of TMO will help in developing inhibitors. Such inhibitors will prevent the formation of galls on the infected plants and there by block the deleterious effects of the infection and increase the agricultural yield. Novel information on the structure function relationships of TMO could be used to increase the yield of crops. This project includes cloning, expressing, and characterizing the TMO, understanding the kinetics of enzyme on substrate specificity and catalysis, identifying the critical protein sequence on activity, and designing novel inhibitors. Recent results indicates, for the first-time the TMO from A. tumefaciens has been cloned.

**2. Brief description of the target audience**

Plant physiology researchers
Biochemists
Agriculture biotechnology companies

## V(E). Planned Program (Outputs)

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

| | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Year** | **Target** | **Target** | **Target** | **Target** |
| **Plan** | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 |

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

| Year | Target |
|---|---|
| **Plan:** | 0 |
| 2007 : | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| | Extension | Research | Total |
|---|---|---|---|
| **Plan** | | | |
| 2007 | 0 | 0 | 0 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- Scientific presentations/publications

| Year | Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

## V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O No. | OUTCOME NAME |
|---|---|
| 1 | Improve plant photosynthesis % |
| 2 | Developing isolation and clonning methodology for TMO |

**Outcome #1**

**1. Outcome Measures**

Improve plant photosynthesis %

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Tryptophan monooxygenase is a flavoenzyme, catalyzes the oxidative decarboxylation of α-amino acids, catalyzes the tryptophan to indoleacetamide and carbon dioxide and water. This is the first step in the synthesis of plant growth hormone by pathogenic bacteria. Upon infection of plants by Agrobacterium tumefaciens, organism produces enzymes required to form Indoleacetic acid at the site of infection. The resulting high levels of IAA at the site of infection results in localized growths, known as galls. Because of the localized growth, health of the plant is compromised. None of the basic enzyme parameters like substrate affinity constants or reactions rates for the TMO of A. tumefaciens have so far been established. And also no structural information of any TMO is yet available. Because of its role in the tumorigenesis, the regulation of IAA synthesis is of interest. Studies on the structure and catalytic mechanisms of TMO will help in developing inhibitors. Such inhibitors will prevent the formation of galls on the infected plants and there by block the deleterious effects of the infection and increase the agricultural yield.

**What has been done**

Isolated and clonned the TMO from agrobacterium tumefaciens.

**Results**

Succesfully isolated and clonned the TMO from agrobacterium tumefaciens.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 206 | Basic Plant Biology |

**Outcome #2**

**1. Outcome Measures**

Developing isolation and clonning methodology for TMO

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | {No Data Entered} | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

The isolation and clonning of TMO has not been documented in the past.

**What has been done**

Isolated and clonned TMO from agrobacterium tumefaciens

**Results**

Succesfully isolated and clonned TMO from agrobacterium tumefaciens

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 206 | Basic Plant Biology |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**

- Other (Other research findings)

**Brief Explanation**

The current/used avaliable technologies applied in the isolation and clonning methodology of TMO are particularly difficult.A great deal of time resource was invested.

## V(I). Planned Program (Evaluation Studies and Data Collection)

**1. Evaluation Studies Planned**

- Retrospective (post program)
- During (during program)

**Evaluation Results**

**Key Items of Evaluation**

**Program #6**

## V(A). Planned Program (Summary)

**1. Name of the Planned Program**

Alternative Agriculture

## V(B). Program Knowledge Area(s)

**1. Program Knowledge Areas and Percentage**

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 201 | Plant Genome, Genetics, and Genetic Mechanisms | | | | 25% |
| 205 | Plant Management Systems | | | | 75% |
| | **Total** | | | | 100% |

## V(C). Planned Program (Inputs)

**1. Actual amount of professional FTE/SYs expended this Program**

| Year: 2007 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 0.0 | 0.0 | 0.0 | 1.0 |
| Actual | 0.0 | 0.0 | 0.0 | 0.5 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 0 | 0 | 0 | 190536 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 0 | 0 | 0 | 133844 |
| 1862 All Other | 1890 All Other | 1862 All Other | 1890 All Other |
| 0 | 0 | 0 | 77210 |

## V(D). Planned Program (Activity)

**1. Brief description of the Activity**

The overall objective of this project is to develop and demonstrate hydroponic, sustainable/organic and ornamental technology and/or production systems suitable for use by small producers.Four types of research were done:evaluation of a hydroponic strawberry system, assessment of small portable greenhouses, trialing of varieties on organic farms and ornamental plant trials.

**2. Brief description of the target audience**

- Farmers/Growers
- Extension Agents
- Horticulturalists/Agronomists
- Master Gardeners
- Germplasm Collectors/Curators
- Plant Breeders
- Plant Geneticists
- Plant Pathologist/Entomologists

## V(E). Planned Program (Outputs)

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

| | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Year** | **Target** | **Target** | **Target** | **Target** |
| **Plan** | 0 | 0 | 0 | 0 |
| 2007 | 25 | 30 | 0 | 0 |

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

| Year | Target |
|---|---|
| **Plan:** | 0 |
| 2007 : | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| | Extension | Research | Total |
|---|---|---|---|
| **Plan** | | | |
| 2007 | 0 | 0 | 0 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- Scientific presentations/publications

| Year | Target | Actual |
|---|---|---|
| 2007 | 1 | 3 |

**Output #2**

**Output Measure**

- Publications for the lay person

| Year | Target | Actual |
|---|---|---|
| 2007 | {No Data Entered} | 5 |

## V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O No. | OUTCOME NAME |
|---|---|
| 1 | Increase small farm profitability % |

**Outcome #1**

**1. Outcome Measures**

Increase small farm profitability %

**2. Associated Institution Types**

•1890 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Quantitative Target | Actual |
|---|---|---|
| 2007 | 0 | 0 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Alternative agriculture products and practices such as organic/sustainable farming and hydroponic systems are becoming an important component in agriculture. Due to the expansion and domination of agribusiness corporations, small farms are unable to remain competitive in traditional crop production and marketing. Alternative approaches to growing crops and production of new or exotic species, can provide a greater return on small farm investment compared to traditional products and practices.

**What has been done**

The overall objective of this project is to develop and demonstrate hydroponic, sustainable/organic and ornamental technology and/or production systems suitable for use by small producers. Four types of research were done: evaluation of a hydroponic strawberry system, assessment of small portable greenhouses, trialing of varieties on organic farms and ornamental plant trials.

**Results**

An off season strawberry production method using a vertical hydroponic system showed promise for production of strawberries for winter harvesting. Our research showed pollination by bees was critical for superior fruit development and production could be timed for targeted production. Commercially available small greenhouses were evaluated for use in producing transplants and extending the season with houseplants. Of the five evaluated, two showed no signs of deterioration after a year of use. Four sites evaluated vegetable and herb varieties for the Organic Seed Partnership. Deer, ground hogs and drought conditions took a toll on the field trials. A cold snap in the spring devastated the 2006 ornamental trials with only three mum lines having more than 50% survival. In 2007 twelve ornamental crops were evaluated for the University of Minnesota including four lily populations, 22 mum lines and 16 miscellaneous.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 205 | Plant Management Systems |
| 201 | Plant Genome, Genetics, and Genetic Mechanisms |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**

- Natural Disasters (drought,weather extremes,etc.)
- Economy
- Appropriations changes
- Competing Programmatic Challenges

**Brief Explanation**

Physical facilities such as fields, greenhouse and lab space are inadequate.
Reduction in funding for fundamental research could have a significant impact on timing of outcomes.

## V(I). Planned Program (Evaluation Studies and Data Collection)

### 1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

**Evaluation Results**

**Key Items of Evaluation**