2009 West Virginia State University Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

West Virginia State University, through its Gus R. Douglass Institute's Agricultural and Environmental Research Station (WVSU AERS), continues to deliver (since 2000) Land-Grant related research programs that are responsive to the needs of the University, the State, and the Country's stakeholders. These programs were structured and are reported within the United States Department of Agriculture's prescribed 5 national priorities (goals) framework. As the University builds research infrastructure and capacity, and is able to secure additional funding resources, existing research programs are further strengthened and new programming is developed to better serve the needs of the University's stakeholders. Federal fiscal year 2009, the year currently being reported, was a successful year for the University from a research development perspective. All research programs, with exception of one, experienced growth in terms of funding and achieving proposed goals. The University's establishment of graduate programs have further benefited the development of research programs in that more graduate students and faculty were able to participate in agricultural and environmental research. The funding received from US appropriations, through USDA Cooperative State Research, Extension and Education Service (USDA-CSREES now NIFA) agency, was allocated to these programs and tracked in terms of its impact through the Plan of Work database means. Below is a detailed summary of each of the plan of work program's components, including inputs, outputs, outcomes and impacts, funding and human resources distribution.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	11.5
Actual	0.0	0.0	0.0	14.5

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

All research programs are subjected to a review process during the months of April and May. This process includes both internal and external evaluation. An oral presentation at the WVSU Annual Research Symposium is also a key component of the overall evaluation and is required for all land-grant sponsored researchers. Stakeholders identified by procedures outlined below are invited to participate in the Symposium as well. The internal evaluation consisted of an Office and/or Department appraisal by the executive staff. Additionally, all participants in land-grant sponsored research critically assess the work of their peers for developmental purposes. As an internal review procedure, the University has also appointed a committee (Land-Grant Advisory Committee) comprised of faculty and staff with the main purpose of tracked progress and provide guidance to some of the programming.

An external research advisory panel conducts the external evaluation component of the overall Land-Grant research programs offered by the University. This panel consists of local scientists with a wide variety of backgrounds, business leaders and community members considered to be suitable stakeholders for research programs. The evaluations from these panels are utilized to restructure research programming and help rank and allocate funds to specific land-grant programs. Evaluation of research productivity versus resources spent is included in the ranking of continuing projects to facilitate funding decisions for the 2010 budget year.

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 the review panel to evaluate the land-grant research programs at the University. The invitation stressed the importance and requirement of our programs to have and input reviewed processed by a diverse stakeholder group. Research administrators and 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 and groups. Several collaborations have been formed as a result of these activities. Traditional stakeholder groups include industry, departments of agriculture, and farmers (e.g. small farmers). Non-traditional groups include non-profit organizations, alternative energy groups 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.

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 our targeted stakeholders. These individuals and organizations were invited directly to participate through a written invitation. Other individuals were encouraged by previous members or other University staff. Thus the research advisory committee consisted of several individuals representing the different areas addressed by the research programs. Target areas were defined based on the research portfolio at the institution. Within each target area, individuals were identified and invited to participate in the advisory process. These individuals advised the scientists on possible stakeholders and issues important to those stakeholders. Also all individual research scientists attended professional seminars, special interest meetings and other relevant conferences, and have identified stakeholders through interactions with groups or individuals interested in their research programs.

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.

As a major component of the semiannual research advisory meetings; advisors, faculty, staff, and administrators engaged in a dialog to discuss major observations or issues the advisors put in front of the University's programs. Also, input in writing was collected after or during the two semiannual reviews. Specific questions formulated in a survey format were handed out before and during the meeting for the advisors to answer. Finally, to document all the discussions that took place during the meetings from committee participants, minutes were assembled and all survey information collected, analyzed and used to guide the programming process of the following research year.

3. A statement of how the input will be considered

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

Brief explanation.

All input received from the research advisory committee was collected in writing as well as from verbal discussion during those meetings. This feedback was used to guide the programming process of the following year's research programming cycle. This input has normally an effect on the distribution of efforts or overall share of research programs. Seldom has this input resulted in the total elimination of a planned research program but it is strongly considered if the recommendation is provided.

Brief Explanation of what you learned from your Stakeholders

Through the stakeholder input, it was learned that some research projects needed additional and enhanced support as they were perceived as critically important to the Institution and the goals under which programs are established by the committee members. Additionally, stakeholders were keenly interested in learning more about the student involvement and interactions with faculty and other research staff in all research programs. To that fact, during the advisory meetings we have now incorporated a student and research staff (non faculty) poster session in which the stakeholder has an opportunity to directly interact and learn more about the work and contributions these members make in terms of research programs. Some stakeholders were also interested in seeing some of this research being commercialized or find an application outside of the University.

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	1319240

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	0	1064708
Actual Matching	0	0	0	938728
Actual All Other	0	0	0	1318275
Total Actual Expended	0	0	0	3321711

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from				
Carryover	0	0	0	414586

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

V(A). Planned Program (Summary)

Program # 1

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
101	Appraisal of Soil Resources				40%
102	Soil, Plant, Water, Nutrient Relationships				10%
133	Pollution Prevention and Mitigation				10%
403	Waste Disposal, Recycling, and Reuse				40%
	Total				100%

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	0.3
Actual	0.0	0.0	0.0	1.2

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	174679
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	154010
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	161535

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 and Environmental groups - Mine operators - Mine and Land owners- Environmental regulators

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	5	0	0	0
Actual	5	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	0	
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific presentations and publications

Year	Target	Actual
2009	1	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased awareness of soil remediation technology among stakholders (%)
2	Development of a novel technique for soil remediation (% completion)
3	Increase restoration of reclaimed land and its use via this technique (%)

Outcome #1

1. Outcome Measures

Increased awareness of soil 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
2009	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
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

Outcome #2

1. Outcome Measures

Development of a novel technique for soil remediation (% completion)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increase restoration of reclaimed land and its use via this technique (%)

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

There is an essential need to strengthen the SOIL microbiology research capacity - by establishing collaboration with other institutes or by hiring and establishing in-house capacity.

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

V(A). Planned Program (Summary)

Program # 2

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				20%
	Total				100%

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	1.0
Actual	0.0	0.0	0.0	2.3

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	216269
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	190679
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	120823

V(D). Planned Program (Activity)

1. Brief description of the Activity

Study 1:

A 2 x 2 factorial experiment was conducted to evaluate the effects of commercial diets (32/3 or 36/8 percent protein/fat, Malick Aquafeed, Inc.) and channel catfish strains (USDA 103 or Norris) on the performance and mitochondrial respiratory chain enzyme activities in the liver, muscle and intestine. Data such as weight gain, feed efficiency, feed consumption, specific growth rate, body composition, visceral fat content, nutrient utilization (protein efficiency ratio, protein productive value, energy efficiency ratio, energy productive value, lipid productive value, and lipid efficiency ratio), respiratory control ratio, and mitochondrial respiratory chain enzyme activities were collected and analyzed.

Study 2:

A 2 x 6 factorial experiment was conducted to evaluate the effects of commercial diets (32/4 or 36/6 percent protein/fat and

channel catfish families/strain (A, B, C, D, E, or F) on the performance, mitochondrial respiratory chain enzyme activities and gene expression levels in the liver, muscle and intestine. The analyses of mitochondrial respiratory chain enzyme activities and gene expression levels were performed on tissues (liver, intestine and muscle) of family/strain C and D with the lowest and highest feed efficiency. Other data collected and analyzed were weight gain, feed efficiency, feed consumption, specific growth rate, body composition, visceral fat content and nutrient utilization (protein efficiency ratio, protein productive value, energy efficiency ratio, energy productive value, lipid productive value, lipid efficiency ratio).

Study 3:

A 2 x 5 factorial experiment was conducted to evaluate the effects of commercial diets (40/10 or 45/19 percent protein/fat, Malick Aquafeed, Inc.) and rainbow trout lots/family (Lot 076, Lot 192, Lot 254, Lot 256 or Lot 257) on the performance, mitochondrial respiratory chain enzyme activities and gene expression levels in the liver, muscle and intestine.Data such as weight gain, feed efficiency, feed consumption, specific growth rate, body composition, visceral fat content, nutrient utilization (protein efficiency ratio, protein productive value, energy efficiency ratio, energy productive value, lipid productive value, and lipid efficiency ratio), respiratory control ratio, mitochondrial respiratory chain enzyme activities, and mitochondrial gene expression levels were collected and analyzed.

2. Brief description of the target audience

The target audience includes fish feed industries, fish farmers and researchers involved in selective breeding and could lead to methods to predict feed efficiency in different stains/families of fish. Additionally, this will be useful in genetic selection for stock improvement.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	10	0	25	0
Actual	4	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	1	
Actual	0	2	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations and/or publications

Year	Target	Actual
2009	1	4

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 discharged 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
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
If modulation of the diet is shown to affect mitochondrial functions and enhance FE it may lead to development of new feeds for aquaculture that reduce the time and cost of bringing fish up to market size. The amount of labor involved in selection of fish for feed efficiency would be reduced dramatically as would the feed and other costs associated with growing fish to food-size or through to selection age.

What has been done
Data such as weight gain, feed efficiency, feed consumption, specific growth rate, body composition, visceral fat content, nutrient utilization (protein efficiency ratio, protein productive value, energy efficiency ratio, energy productive value, lipid productive value, and lipid efficiency ratio), respiratory control ratio, mitochondrial respiratory chain enzyme activities, and mitochondrial gene expression levels were collected and analyzed.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #2

1. Outcome Measures

Reduce nitrogen and phosphorus in discharged water (%)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	20	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasing feed efficiency may allow for fish to be kept at higher densities without decreasing water quality. An environmental side benefit could be that fish selected and bred for greater feed efficiency would produce lower volumes of aquaculture waste pollution because of improved feed utilization.

What has been done
Data such as weight gain, feed efficiency, feed consumption, specific growth rate, body composition, visceral fat content, nutrient utilization (protein efficiency ratio, protein productive value, energy efficiency ratio, energy productive value, lipid productive value, and lipid efficiency ratio), respiratory control ratio, mitochondrial respiratory chain enzyme activities, and mitochondrial gene expression levels were collected and analyzed.

Results
This study provides insight into possible relationships between respiratory chain activity and other growth performance traits such as body size and feed consumption while also revealing possible detrimental effects of using "nutrient-dense" diets in aquaculture production systems when fish are fed large amounts of feed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #3

1. Outcome Measures

Increased profitability of aquaculture operations (%)

Not Reporting on this Outcome Measure

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

V(A). Planned Program (Summary)

Program # 3

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: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	2.6
Actual	0.0	0.0	0.0	2.7

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	222923
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	196546
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	431625

V(D). Planned Program (Activity)

1. Brief description of the Activity

A long-term experiment was begun in 2008 to investigate the technological feasibility of co-digesting poultry litter and thin corn stillage in a thermophilic anaerobic digester. During 2009 an experiment was initiated in order to test the limits of codigestion of litter and stillage in terms of digester performance using replicate 10 liter digesters. This experiment was run in parallel with the pilot plant experiment but continued the codigestion treatments at higher percentages of stillage.

Additional research focused on understanding how microbial community metabolic diversity gives rise to the performance characteristics of thermophilic anaerobic digestion. Analysis was done on microbial population data obtained through pyrosequencing of several previous pilot plant and biofilm experiments; including a hydraulic retention time experiment with the pilot plant, and an experiment with a 15 liter biofilm digester. Another major activity was initiation of a metagenomic study of the pilot plant digester.

The ongoing study of linking microbial populations to their functional roles in the digester community continued. The goal was to establish stable long-term 500 ml laboratory digesters that can be analyzed with stable isotope probing (SIP). The primary method employed was stable isotope probing using 13C-labeled substrates in 500 ml model digesters. Small-scale digesters are a particular challenge to operate because they are less stable than larger digesters. Three digesters were successfully stabilized during 2009 which will be used for SIP analysis in 2010.

2. Brief description of the target audience

- Anaerobic digester engineers and operators - Poultry industry - Livestock producers - Microbiology researchers

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.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	10	0	0	0
Actual	10	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	0	
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific publications and/or presentations

Year	Target	Actual
2009	2	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase knowledge of anaerobic bacteria (%)
2	Increase digester efficiency (%)
3	Increase knowledge of microbial biomass-to-bioenergy conversion process (%)

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
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The anaerobic digestion (AD) research at WVSU has several practical benefits that could have biotechnological applications and economic value. 1) anaerobic digestion can make a significant contribution to the renewable energy economy of the United States. It is an excellent method for recovering energy as methane from agricultural wastes and other organic wastes produced by many industries. 2) AD contributes to a sustainable environment by reducing the harmful side effects of organic wastes. It reduces the total quantity of organic wastes produced by society, as well as reduces or eliminates the presence of harmful human, animal and plant pathogens in wastes. AD is also an excellent means of reducing the amount of organic waste that contaminates watersheds near animal farms. 3) WVSU uses genetic methods that allow us to survey and discover useful metabolic properties in AD.

What has been done
Pyrosequencing data obtained from several previous pilot plant and biofilm experiments was analyzed; including a hydraulic retention time experiment with the pilot plant and a two year experiment with a 15 liter biofilm digester.

Total community DNA from the digester was purified, and utilized the new Titanium pyrosequencing method available at the Carver Biotechnology Center of the University of Illinois. The experiment yielded impressive results.

Three digesters were stabilized during 2009 which will be used for SIP analysis in 2010.

Results
1.2 million DNA sequences were obtained, representing more than 500 million base pairs of DNA. This is the largest metagenomic sample that has ever been acquired from a digester and may even be the largest metagenome from any type of bioreactor. The data is being analyzed using the on-line MG-RAST server which is available through Argonne National Laboratory.

The data set obtained used pyrosequencing of PCR-amplified 16S rDNA and produced more than 40,000 sequences and 30 million base pairs of DNA. We are interpreting population diversity data to correlate microbial activity with digester performance.

4. Associated Knowledge Areas

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

Outcome #2

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
2009	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The anaerobic digestion (AD) research at WVSU has several practical benefits that could have biotechnological applications and economic value. 1) anaerobic digestion can make a significant contribution to the renewable energy economy of the United States. It is an excellent method for recovering energy as methane from agricultural wastes and other organic wastes produced by many industries. 2) AD contributes to a sustainable environment by reducing the harmful side effects of organic wastes. It reduces the total quantity of organic wastes produced by society, as well as reduces or eliminates the presence of harmful human, animal and plant pathogens in wastes. AD is also an excellent means of reducing the amount of organic waste that contaminates watersheds near animal farms. 3) WVSU uses genetic methods that allow us to survey and discover useful metabolic properties in AD.

What has been done
Codigestion limits were tested, using replicate laboratory-scale digesters, to evaluate how digesters stabilized on one feed (poultry litter) performed when the feed composition was changed (codigestion). Treatment digesters were fed with 100% poultry litter, 20% stillage and 40% stillage; a control digester received 100% litter. The digesters were operated for two hydraulic retention times (HRT) (15 days each) for each treatment. Standard chemical analyses were performed to evaluate digester performance.

Results
After the end of one HRT, stable performance was observed with high level of methane in the biogas (64%), COD removal (62%) and lowering of volatile acids. The concentrations of volatile fatty acids (propionate and acetate) especially increased in the 20% treatment but decreased drastically along with a drop in pH (7.8 to 7.5) in the 40% treatment.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Increase knowledge of microbial biomass-to-bioenergy conversion process (%)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	5	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The anaerobic digestion (AD) research at WVSU has several practical benefits that could have biotechnological applications and economic value. 1) anaerobic digestion can make a significant contribution to the renewable energy economy of the United States. It is an excellent method for recovering energy as methane from agricultural wastes and other organic wastes produced by many industries. 2) AD contributes to a sustainable environment by reducing the harmful side effects of organic wastes. It reduces the total quantity of organic wastes produced by society, as well as reduces or eliminates the presence of harmful human, animal and plant pathogens in wastes. AD is also an excellent means of reducing the amount of organic waste that contaminates watersheds near animal farms. 3) WVSU uses genetic methods that allow us to survey and discover useful metabolic properties in AD.

What has been done
A long-term experiment was begun in 2008 to investigate the capacity of thermophilic anaerobic digestion to recover additional energy from a variety of types of waste biomass including agricultural residues, ethanol manufacturing and other industrial wastes. The experiment that was begun during fall 2008 was divided into two phases. The was accomplished during fall 2008 and the second during 2009. The purpose of the experiment was to test whether the WVSU thermophilic digester, which has been stabilized for several years on poultry litter, can co-digest ethanol stillage, and to evaluate the efficiency of energy recovery.

Results
A full range of performance parameters was recorded including methane production, total volatile acid concentration, individual fatty acid concentrations and COD. These data are currently being analyzed. However, the experiments demonstrated a high production of methane during codigestion with both 20% and 40% stillage. A paper is in preparation f and will be submitted to a peer reviewed journal.

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
- Appropriations changes
- Government Regulations

Brief Explanation

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

V(A). Planned Program (Summary)

Program # 4

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: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	5.2
Actual	0.0	0.0	0.0	4.5

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	282813
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	249350
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	513307

V(D). Planned Program (Activity)

1. Brief description of the Activity

Use of a molecular marker to track the transfer of the Ph3 gene for Late Blight has been integrated into the tomato breeding program. Marker assisted selection (MAS) was used to select at the seedling stage plants from lines identified for segregation. Also, selection for superior plant habit and fruit quality continued in the 2008 selections. It also appears that breeding lines may be earlier than the standard greenhouse lines, which would be an additional benefit to growers.

DNA markers, genetic maps, QTLs for various traits are being identified in crops including watermelon, melon, sesame, cotton, sweet potato, peppers and pumpkins. Novel parental lines are being developed to identify superior seedless watermelon

varieties. Genetic populations for various traits were made in several crops. Integration of data from genetic maps, diversity studies, physical mapping and functional genomics continues to be a chief priority. Recruitment and retaining of research staff is also an important components. Strengthening teaching, training and outreach activities along with the laboratory maintenance and further modernization is another priority.

2. Brief description of the target audience

-Horticulturists

-Greenhouse Industry

-Plant Genetics Researchers

-Graduate and undergraduate students

-High school students and teachers

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 2
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	0	
Actual	0	2	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific publications and/or presentations

Year	Target	Actual
2009	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
2009	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
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

2009	2	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

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

Evaluation Results

This is one of the most successful programs in terms of resources coming to this program as the researchers aggressively pursue other sources of funding (e.g. NSF, NIH, Capacity Building, etc.). The program and its participants will be retained and further supported.

Key Items of Evaluation

This research is currently being monitored to find a more commercial or off-campus applications through extension service.

V(A). Planned Program (Summary)

Program # 5

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: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	1.8
Actual	0.0	0.0	0.0	0.0

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	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This research program has been halted due to the lost of research personnel. Since this program has partial funding support from the industry (Dow Chemical former Union Carbide), the program is being currently re-assessed between the organization and University officials in terms of its future focus. It is likely that this program will be restructured with a new focus; still within the agricultural biotechnology area.

2. Brief description of the target audience

Plant physiology researchers Biochemists Agriculture biotechnology companies Agricultural Crop Producers/Growers

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	5	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	1	
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific presentations/publications

Year	Target	Actual
2009	1	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Improve plant/crop yield/productivity (%)

Outcome #1

1. Outcome Measures

Improve plant/crop yield/productivity (%)

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Other research findings)

Brief Explanation

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

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)
- Other (Program Annual Evaluation)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

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: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	1.0
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	168024
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	148143
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	90985

V(D). Planned Program (Activity)

1. Brief description of the Activity

evaluation of an alternative media component in a vertical hydroponic system, variety trials - vegetable, fruit and ornamental, and development of a cayenne pepper and watermelon OP varieties for release.

We have done one trial (herbs and edible flowers) and completed the second trial (winter production of strawberries) to test rice hulls as an alternative not just for use by stakeholders but also to see if we could switch to this for our hydroponic trials and use it in the tomato breeding project (see Plant Genomics).

The four crops we focused on were tomatoes, peppers (sweet and hot), cucumbers and melons. The tomatoes chosen were across the spectrum in both size and color. In addition, as we have done for the prior three years, we raised seedlings for several growers that were part of the OSP trials. We also grew plants in the field for use at the WV

State Fair for tasting purposes.

One is a variant of the "Moon & Stars" melon that has a striped background instead of the standard green rind. Cayenne peppers from an early dwarf cayenne line with a narrow and long fruit shape were also saved from a segregating line trialed as part of the OSP in 2007.

Data along with photographs were taken on transplant survival, flowering and other phenotypic traits. In addition, several cut flower crops were also planted in the ornamental trial site.

2. Brief description of the target audience

- Farmers/growers
- Organic farmers/growers
- Hydroponic growers
- Greenhouse growers
- Horticulturists

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	20	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	1	
Actual	0	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific presentations/publications

Year	Target	Actual
2009	2	4

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
2009	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small farm agriculture is not the focus as more alternative agriculture products and practices such as organic/sustainable farming and hydroponic production are becoming important to the industry, government and consumers. While small farms will never be able to compete with the large agribusiness corporations, there are ways small and alternative agriculture ventures can compete by growing crops or producing of new or exotic species, as well as focusing on organic and sustainable production practices.

What has been done
Four types of research were done in 2009: evaluation of an alternative media component in a vertical hydroponic system, variety trials - vegetable, fruit and ornamental, and development of a cayenne pepper and watermelon OP varieties for release.

Results
As in 2008, use of rice hulls as a substitute for perlite in hydroponic growing media showed promise. There are challenges including uneven wetting of the media and attraction of rodents. Work with strawberries, herbs and edible flowers showed little to no difference in the parameters measured. Tomatoes were challenged with unusually severe blight and possibly Septoria problems in summer of 2009, which devastated the field trials. Melon and pepper lines were selected that fit the plant habit and fruit type desired. Winter survival of the 2008 ornamental plantings was better with more than 50% survival in the mums and over 30% with the lilies. Two mum selections and two lavender selections had 100% survival. In addition, five lily selections which had multiple stems were sent back to the collaborator after assessing winter survival.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

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