2011 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 (WVSU), via the Gus R. Douglass Institute's (GRDI) Agricultural and Environmental Research Station (AERS), continues to deliver land-grant related research programs that are responsive to the needs of the University, the State, and the Nation's stakeholders.

Since regaining land-grant status in 2000, GRDI is continuing to expand research capacity and is working to integrate research, teaching and outreach programs. As the University builds research infrastructure and capacity, and is able to secure additional funding sources, existing research programs are further strengthened and new programming is developed to better serve the needs of the University's stakeholders.

The establishment of the MS graduate program in Biotechnology within the College of Natural Sciences and Mathematics has further benefited the development and maturation of research programs. Split appointments of graduate research faculty within GRDI have permitted the increased participation of undergraduate and graduate students in the agricultural and environmental research.

The following report details the programs supported by Evans-Allen funds appropriated to the 1890 Institutions and matching funds provided by the State of West Virginia. The corresponding National Institute of Food and Agriculture Priority Program will be identified for each Planned Program.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	16.0
Actual	0.0	0.0	0.0	11.5

II. Merit Review Process

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

- Combined External and Internal University External Non-University Panel
- Other (10-Year External Review)

2. Brief Explanation

All research projects are subjected to both an internal and external annual review. The internal review consists of quarterly or semester reports that detail work accomplished during that time period, including research progress, student involvement, publications and presentations, collaborations, and stakeholder involvement. This information is also summarized in the annual CRIS report and impact statements. The reports are reviewed by the Associate Dean and Associate Director of Research and are

integral to the evaluation process. The College of Natural Sciences and Mathematics sponsors the annual WVSU Research Symposium during which all students and research faculty make presentations of their work. This permits a feedback mechanism among and within the WVSU community.

In the spring and fall of each year, the newly formed Research and Extension Advisory Council (REAC) is convened to review the research and extension programs together. The Advisory Council is composed of stakeholders external to WVSU representing university faculty, local community and business leaders, farmers and other entrepreneurs with and interest in our program. REAC was formed to further the integration of the Research and Extension programs.

In the Fall of 2011, we had an additional review of the entire LGP to commemorate the 10-Year anniversary of the reinstatement of land-grant status at WVSU. A select panel of former GRDI employees and stakeholders were brought to campus for an additional program review in addition to the REAC meeting.

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 research programs to have both basic and applied relevance, collaboration, student involvement and a regular evaluation and assessment process 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 representatives of university research, industry, state departments of agriculture, federal agencies, and lay people including small farmers and entrepeneurs.

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.

The goal of the Research and Extension Advisory Council is to have one or two individuals on the council who are in a position to provide analysis and feedback on each of the planned programs. Potential council members are recommended each year by administrators, faculty and researchers and non-participating members are dropped to maintain a functioning council.

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 and Extension Advisory Council 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

The focus of this year's advisory council was a better integration of the research and extension programs. Rather than having an individual advisory council for research and extension, the councils were combined for the first time. This enabled feedback from not only the external council members, but research and extension faculty were able to provide feedback and explore ways to better integrate their efforts. All future advisory council meetings will be integrated in nature.

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	1477711

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	0	1311677
Actual Matching	0	0	0	973956
Actual All Other	0	0	0	0
Total Actual Expended	0	0	0	2285633

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	788698

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Sustainable Environment and Renewable Resources

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships				20%
112	Watershed Protection and Management				10%
123	Management and Sustainability of Forest Resources				30%
206	Basic Plant Biology				10%
403	Waste Disposal, Recycling, and Reuse				30%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	3.3
Actual Paid Professional	0.0	0.0	0.0	4.0
Actual Volunteer	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	459087
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	340884
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

The pilot plant digester performance was evaluated with a mixing experiment. Mixing is accomplished in this digester by recirculating head-space gas through the liquid. A new pilot-scale plugflow thermophilic digester was successfully started. Evaluation of the hydrodynamics and mathematical modeling of the pilot plant digester are being conducted by a collaborator from Universidad Autonoma Chapingo (Mexico). This work is still in progress.

A long-term experiment was continued with replicate bench-scale digesters to test the stability of the anaerobic digestion process in terms of the major metabolites and the composition of the microbial communities through time. The microbial community in these digesters was sampled with pyrosequencing. The persistence of major and minor populations was evaluated.

Mine land reclamation activities included establishing collaboration with active mine operator and landowner. Also, field experiment was installed to test different poultry litter digest products at different application rates in combination with three different seed mixes; soil and vegetation parameters are evaluated annually.

To address storm water management goals, state and local government were approached to provide input on mitigation practices of interest. A team of experts was assembled to identify soil, landscape, hydrology, and geology parameters relevant to the performances of the practices of interest. Collaboration with USDA NRCS was put in place to develop the rating tool based on NRCS soil survey data and an NRCS NASIS logic model was used to develop a soil rating tool.

2. Brief description of the target audience

Digester Technology - Industries which produce organic wastes, poultry farmers, other agricultural waste producers, environmentally concerned citizens, undergraduate and graduate students in biotechnology, engineers and scientists who study bioreactors and anaerobic microbial processes.

Mine land reclamation - mine operators, mine reclamation contractors, land owners.

Storm water - state and local government, MS4's municipalities, contractors and landscape architects and designers, privet land owners.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	40	0	0	0

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

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	2	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific presentations and publications

Year	Actual
2011	5

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
3	Develop soil rating for soil-based runoff mitigating practices
4	Increase digester efficiency
5	Develop techniques for digester control
6	Increase knowledge of anaerobic bacteria
7	Increase knowledge of microbial biomass-to-bioenergy conversion process

Outcome #1

1. Outcome Measures

Increased awareness of soil remediation technology among stakholders

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Development of a novel technique for soil remediation

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Current practices of mine reclamation result in rather poor and non-productive soil, and further input and improvement of current practices is needed to improve soil and site productivity. Productive mine land will increase overall cultivated land inventory, increase local and national food fiber and energy production, and will contribute to local economy by turning these idle lands into cash crop productive ones. Moreover, improving soil productivity result in healthier cover vegetation that further improve impact of mining operation on the environment by reducing runoff and soil erosion, and hence improving freshwater bodies ecology, fishery, and water quality.

What has been done
Field study was install on previously reclaimed mine site. The experiment included two poultry litter digest products that were applied at three rates to field plots organized in a complete randomized block design. Soil amendment treatments were applied in a factorial manner to three different seed mixes. Plant establishment and botanical composition is measured in late spring and early fall, annually. Soil samples are taken every fall and tested for chemical, physical and biological properties.

Results

Poultry litter digest application improved soil organic matter content, nutrient content and availability, and improve soil structure. It further improved plant establishment and percent of vegetation coverage of the plot. Originally seeded plants were displaced by native vegetation. Legume plants did better on non-amended soil, likely due to diminish advantage for N-fixing plants in the amended soils that contained N.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
403	Waste Disposal, Recycling, and Reuse

Outcome #3

1. Outcome Measures

Develop soil rating for soil-based runoff mitigating practices

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
USEPA require urban areas and populated counties to manage and treat their storm water. Un-managed storm water increases surface runoff and soil and riverbed erosion, adversely impact soil and water quality, as well as downstream ecosystem such as fish habitat, and quality of fresh water bodies. Matching storm water management practice of choice to the characteristics of an area of interest is important in assuring proper and efficient performance of the practice.

What has been done
State and local government provide information about storm water management practices of interest. A team of experts was assembled to identify soil, hydrology, geology, and landscape parameters that affect practice performances. Impact of each parameter on each practice was rated. NRCS soil survey database and NASIS logic model were used to develop a soil interpretation that rate the suitability of an area of interest to a storm water management of choice.

Results

The soil-based storm water management practices rating tool was successfully test-run on several counties in WV and will become available on-line through NRCS web site for public use in 2012.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
403	Waste Disposal, Recycling, and Reuse

Outcome #4

1. Outcome Measures

Increase digester efficiency

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Anaerobic digestion (AD) has several practical benefits. Anaerobic digestion can make a contribution to the renewable energy economy of West Virginia and the United States by recovering bioenergy as methane from agricultural and other organic wastes produced by many industries. AD also contributes to a sustainable environment by reducing the harmful side effects of organic wastes, such as human, animal and plant pathogens. It is also an excellent means to reduce the amount of organic waste that contaminates watersheds near animal farms, such as the Potomac River region. The value of AD is further increased through the process of co-digestion where several types of organic wastes are simultaneously treated.

What has been done
During 2011 a mixing experiment was performed with the WVSU pilot plant thermophilic digester to test whether mixing is essential for this continuous stir tank reactor (CSTR) design. Mixing is accomplished in this digester by recirculating head-space gas through the liquid. A long-term experiment was continued with replicate bench-scale digesters to test the stability of the anaerobic digestion process in terms of the overall system metabolism and the composition of the microbial communities through time. The microbial communities in these digesters was sampled with pyrosequencing. A pilot-scale plugflow thermophilic digester was started using inoculum

from the WVSU pilot plant digester. Two additional bench-scale digesters were set-up

Results
The pilot plant digester was run with 100% poultry litter, and the performance was compared with and without mixing. This experiment showed that digester performance was slightly diminished following the cessation of mixing, but was not dramatically altered. The start-up of a pilot-scale thermophilic plugflow poultry litter digester was successful.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Develop techniques for digester control

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Anaerobic digestion (AD) has several practical benefits. Anaerobic digestion can make a contribution to the renewable energy economy of West Virginia and the United States by recovering bioenergy as methane from agricultural and other organic wastes produced by many industries. AD also contributes to a sustainable environment by reducing the harmful side effects of organic wastes, such as human, animal and plant pathogens. It is also an excellent means to reduce the amount of organic waste that contaminates watersheds near animal farms, such as the Potomac River region. The value of AD is further increased through the process of co-digestion where several types of organic wastes are simultaneously treated.

What has been done
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experiment was continued with replicate bench-scale digesters to test the stability of the anaerobic digestion process in terms of the overall system metabolism and the composition of the microbial communities through time. The microbial communities in these digesters was sampled with pyrosequencing. A pilot-scale plugflow thermophilic digester was started using inoculum from the WVSU pilot plant digester. Two additional bench-scale digesters were set-up.

Results
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4. Associated Knowledge Areas

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

Outcome #6

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	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Anaerobic bacteria are the metabolic engines that create the anaerobic digestion process as well as drive the global carbon cycle. The success of anaerobic decomposition requires the cooperation of many different types of bacteria that must work in synergistic relationships. These microbes and their interactions are still poorly understood. Many industrial processes use consortia of anaerobic bacteria to produce products. This objective advances the basic science of anaerobic degradation and its biotechnological applications.

What has been done
DNA pyrosequencing was used to characterize the microbial communities in the WVSU pilot plant digester and in replicate bench-scale digesters. Metagenome sampling of the WVSU digester

was done and comparative metagenomics analysis was used to compare this microbiome to other metagenomes from anaerobic environments.

Results
The analysis provided a new understanding of the range of variation of microbial diversity found in replicate digesters, and is allowing us to link microbial community structure to the performance of digesters. The WVSU poultry litter digester has considerable similarities with the guts of some herbivorous animals and termites.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
403	Waste Disposal, Recycling, and Reuse

Outcome #7

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	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The primary method for producing bioenergy is to use anaerobic bacteria that can extract electrons from biomass and use them to produce useful types of bioenergy such as methane, hydrogen and hydrocarbons. Efficient anaerobic bioenergy production requires stable, dependable bioreactors. However, anaerobic bioreactors can be thrown into unstable states by stressful environmental conditions. The application of microbial ecology principles to bioenergy production should lead to improvements in the process.

What has been done
Three replicate anaerobic digesters were operated through 2011 following a previous codigestion experiment. These digesters provided the opportunity to investigate how bioenergy production is related to microbial community structure and environmental variability. Time series analysis was performed on the digester performance variables. Five additional bench-scale thermophilic CSTR

digesters were started for this research.

Results
The energy production as well as several performance variables (COD, VA concentration) of these digesters stabilized at different levels. The microbial community structures of these digesters diverged during a codigestion experiment, and converged when the original feed source was reinstated. The stability experiments have provided evidence that digesters can enter what are referred to in ecology as alternative stable states. These results will help to re-define the concept of stability as applied to anaerobic bioreactors and bioenergy production.

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
- Other (change in personnel)

Brief Explanation

One half-time scientist left the project in summer 2011. One new MS degree student began working with the plug flow digester research. Two MS degree students began setting up replicate bioreactors for long-term studies of anaerobic microbial ecology. A new collaboration was established with a microbial biotechnologist at the Universidad Autonoma de Coahuila (Mexico).

V(I). Planned Program (Evaluation Studies)

Evaluation Results

After 10 years the anaerobic digestion program is being re-evaluated. Personnel changes will be required after termination of a special grant, and an extension component must be added.

Key Items of Evaluation

The Anaerobic Digestion Program or Bioplex was the original research project after reinstatement of land-grant status in 2001. The program has been partially supported by a Special Grant that expired in 2011. The program is being re-evaluated and a new position is being explored to add a full-time researcher and a partial extension component.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Competitive and Sustainable Agricultural Systems

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				19%
202	Plant Genetic Resources				18%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants				10%
204	Plant Product Quality and Utility (Preharvest)				3%
211	Insects, Mites, and Other Arthropods Affecting Plants				7%
212	Pathogens and Nematodes Affecting Plants				10%
302	Nutrient Utilization in Animals				33%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	5.2
Actual Paid Professional	0.0	0.0	0.0	7.5
Actual Volunteer	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	852590
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	633072
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

Plant genomics projects were very active. A variety of annual and perennial cut flowers were evaluated on campus using plastic mulched beds with irrigation. Thirty-four pepper varieties were planted in the Research Station field including green and colored bell pepper varieties, a wide variety of hot peppers and 6 breeding lines of cayenne types. Also, a trial of vertical hydroponic production with four substrates was undertaken with basil, edible flowers and cut flowers. A control substrate (perlite/coir) was compared to three other substrates, ricehulls/coir, perlite/kenaf and ricehulls/kenaf.

In the melon studies, crosses were made among diverse parents to incorporate quality traits and disease resistance (powdery mildew and Fusarium). Observations were recorder on various morphological and fruit characters. Eighty-seven melon collections have been screened with 200 SSR primers for LD (Linkage Disequilibrium), structure and association mapping studies. Advanced breeding lines have been evaluated in farmers' fields.

In addition, genotyping experiments were carried using the Illumina BeadExpress platform on the genomic DNAs of a mapping population (94 progenies) and 288 genbank accessions containing 273, 9 and 6 accessions of var. lanatus (Citrullus lanatus var. lanatus), citroides (Citrullus lanatus var. citroides) and colocynthis (Citrullus colocynthis) respectively. A genetic map was constructed by integrating SNP data with the previously mapped 120 microsatellite markers. Molecular diversity data was further used to analyze the population structure and LD blocks. We identified SNP haplotypes within the cultivated watermelon. Fruit quality data obtained from the field evaluation of 40 cultivated watermelons provided preliminary insights into the use of SNP data for association mapping strategies.

In aquaculture, two feeding trials were completed and growth performance characteristics determined. Tissues were collected after the completion of feeding trials for biochemical and genomic analyses. The mitochondrial complexes enzymatic activities have been completed and analyzed statistically. The genomic analyzes of some of the genes involved in oxidative phosphorylation is ongoing.

2. Brief description of the target audience

-Horticulturists
-Germplasm Collectors
-Plant Genetics Researchers
-Plant Breeders
-Fish Breeders/Farmers

-Private seed companies
-Local Producers/Growers
-Graduate and undergraduate students
-High school students and teachers
-Aquaculture feed manufacturers

3. How was eXtension used?

Use of eXtension occured through participation three communities of practice (CoP): Plant Breeding and Genomics, eOrganic and Consumer Horticulture. In January 2011, the Plant Breeding and Genomics CoP was launched which culminated from the work of the SoCAP outreach content committee of which one of our staff has worked with it from the beginning. Peer reviewed articles were published via the Plant Breeding and Genomics CoP and "Ask an Expert" questions were answered for all three CoP.

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	450	250	48	20

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

Patent Applications Submitted

Year: 2011
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	8	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific publications and/or presentations

Year	Actual
2011	23

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Develop tomatoes for greenhouse production with disease and insect resistance.
2	Genetic maps and genes for vegetable crops
3	Increase state production and sales of alternative agricultural products
4	Increase profitability of aquaculture operations
5	Reduce nitrogen and phosphorus in discharge water
6	Lower aquaculture feed costs

Outcome #1

1. Outcome Measures

Develop tomatoes for greenhouse production with disease and insect resistance.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The number of farms in West Virginia has increased in the ten years with the majority being owned by a family or individual. The number of vegetable farms has almost doubled in the last five years but with only a small change in the acreage. This suggests that new small farms are on the increase focusing on high density production of horticultural crops. In addition, the number of square feet under protection for total greenhouse vegetables and fresh cut herbs has also more than doubled in the last five years with the majority of this focused on greenhouse tomato production.

Protected culture production of tomatoes (Solanum lycopersicum L., formerly Lycopersicon esculentum Mill.) is best with varieties bred for this environment. In addition, the controlled environment conditions of protected culture production generates higher yields from varieties bred for the this environment than the field varieties. Most of the varieties used in Europe for greenhouse production are bred for northern European conditions and palate with no breeding of tomato varieties specifically for high tunnel production.

What has been done
Standard tomato varieties, advanced breeding lines and germplasm were put into a bato bucket hydroponic system following marker assisted selection for the late blight genes, Ph3 and Ph2. Crosses were made between lines with superior taste qualities and lines homozygous for late blight resistance gene, Ph3 with seed harvested and expected to be planted for evaluation next year. Additional crosses were made between superior tasting lines and the insect resistance that was obtained from Cornell and seed from this was obtained. An additional 30 breeding lines were harvested from the plants that were used by our summer SURE student which will be used in the breeding program and to identify better markers to use for Ph2 and Ph3.

Results
Problems were encountered with the molecular markers for the Ph2 and Ph2 genes we obtained from the collaborator. We re-evaluated the material to determine the actual genotype of the breeding lines with Ph3, but still have problems with these markers. We are investigating the potential to develop markers to use with our breeding material. Due to the large distance in basepairs (25Mbp) between the three markers we have used for Ph3, we evaluated lines assumed to be stable or segregating for the markers and obtained seed of these to use in future breeding and marker development.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)

Outcome #2

1. Outcome Measures

Genetic maps and genes for vegetable crops

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The US melon growers are seeking to diversify melon varieties and rotate them every season, while protecting this vulnerable crop from phytopathogens. Development of high quality disease resistant melon varieties is critical to the economic prosperity of US melon farmers. Due to complex inheritance of yield, resistance and stress related traits and their low heritabilities, breeding for yield in melons is very difficult. This challenging objective is much more complicated as yield traits are controlled by quantitative loci. Understanding the genetic control of phenotypic variation is an important first step in order to utilize marker assisted breeding of yield components in melon morphotypes.

What has been done
Crosses were made among diverse parents to incorporate quality traits and disease resistance to powdery mildew and Fusarium in melon.

Observations were recorder on various morphological and fruit characters.

Eighty-seven melon collections have been screened with 200 SSR primers for LD (Linkage Disequilibrium), structure and association mapping studies.

Advanced breeding lines have been evaluated in farmer's fields.

LD patterns were estimated across the melon genome by using 112 mapped SSR markers from the published literature, EST based SSRs and 2938 AFLPs.

Results

LD analysis concluded that higher linkage disequilibrium (LD) existed across the melon genome of Ukrainian collections than those of the US. This study indicated that the introgression of allele combinations of higher LD from Ukrainian melons to the US melons or vice versa will be easier than the allele combinations of lower LD. Knowledge of LD pattern across the allele combinations will facilitate efficient marker assisted selection (MAS).

Common markers were identified for fruit yield and soluble solids that can be used for marker-assisted selection to simultaneously improve yield and quality. Seven markers were identified to be linked with the resistance to powdery mildew.

Graduate students and undergraduate students associated with the research activities of this program have been exposed to various filed and lab techniques like selfing, crossing, molecular marker development and marker analysis.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

Outcome #3

1. Outcome Measures

Increase state production and sales of alternative agricultural products

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increase profitability of aquaculture operations

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Selecting improved strains of aquaculture species that reach market size within the shortest possible time through genomic-based nutritional approach will reduce the time required for the fish to reach market size, thus reducing cost of production and increasing profitability. Selection strains with improved mitochondrial function (increase nutrient utilization efficiencies) will lead to reduction of pollution associated with aquaculture production and subsequently reduce cost associated with pollution control, thus, increasing profitability.

What has been done
A 2 x 3 factorial experiment was conducted to determine effect of trout families (designated as low FE and high FE) and diets (40/10 or 40/20 or 40/30 percent crude protein/fat) on the growth performance characteristics, mitochondrial respiratory enzymatic activities and gene expression in the liver, muscle and intestine. Another 2 x 3 factorial experiment was conducted to determine effect of trout families (designated as low FE and high FE) and diets (45/10 or 45/20 or 45/30 percent crude protein/fat) on the growth performance characteristics, mitochondrial respiratory enzymatic activities and gene expression in the liver, muscle and intestine.

Results
There were issues with water temperature regulation and the experiment was terminated after 90 days instead of 112 days. The wet lab was completely renovated and replaced with a new closed, recirculating water purification system, filters, aquaria and temperature controls.

The extraction procedure for some tissues, especially muscle was changed because of low yield of mitochondrial protein.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #5

1. Outcome Measures

Reduce nitrogen and phosphorus in discharge water

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wastes discharges from aquaculture operations from uneaten feed and unutilized or underutilized nutrients contribute to the pollution of the receiving water bodies. Designing diet that maximizes nutrient utilization efficiencies will lead to reduced waste discharges. Selecting strains with improved mitochondrial function (increase nutrient utilization efficiencies) will lead to reduction of pollution associated with aquaculture production and subsequently reduce cost associated with pollution control, thus, increasing profitability.

What has been done
A 2 x 3 factorial experiment was conducted to determine effect of trout families (designated as low FE and high FE) and diets (40/10 or 40/20 or 40/30 percent crude protein/fat) on the growth performance characteristics, mitochondrial respiratory enzymatic activities and gene expression in the liver, muscle and intestine. Another 2 x 3 factorial experiment was conducted to determine effect of trout families (designated as low FE and high FE) and diets (45/10 or 45/20 or 45/30 percent crude protein/fat) on the growth performance characteristics, mitochondrial respiratory enzymatic activities and gene expression in the liver, muscle and intestine.

Results
From the result, dietary composition had a significant main effect on weight gain, feed efficiency and specific growth rate with fish fed diet 40/30 having a significantly lower weight gain, feed efficiency and specific growth rate when compared to those fed diets 40/10 and 40/20 even when there was no difference in the amount of feed consumption among the different diets. However, family type had no significant effect on weight gain, feed intake, feed efficiency and specific growth rate. Visceral fat and hepatosomatic index were significantly affected by diet where

rainbow trout fed 40/30 had a significantly higher visceral fat when compared to those fed the other two diets. In terms of nutrient utilization efficiencies, there was no difference between family 120 and family 136 but those fed diet 40/10 had a significantly better LPV and LER when compared to those fed diets 40/20 and 40/30. There was significant interaction between family and diet for weight gain and specific growth rate. There were significant interaction between diet and family for mitochondrial state 3 and state 4 respiratory control ratios. Significant differences were also seen between the rainbow trout families and the different diets in terms of mitochondrial respiratory chain enzyme activities and there were variations in the mitochondrial complex enzyme activities in different tissues.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #6

1. Outcome Measures

Lower aquaculture feed costs

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Facility Renovation and Space)

Brief Explanation

The size and extent of vegetable breeding studies is limited by the amount of available field and greenhouse space. Local farmers are being recruited to place field experiments on their farms.

The aquaculture wet lab was completely renovated to install a recirculating aquaria system. This has delay experiements but will provide much more reliable data in the future.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As per the objectives listed, the progress is quite satisfactory. Breeding populations have been generated by crossing with resistant cultivars and developed marker resources and mapped some of them.

Key Items of Evaluation

Breeding material generated for melon
Marker resources for melon
Number of papers published
Number of students trained

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Food Systems, Nutrition and Wellness

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
703	Nutrition Education and Behavior				100%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	1.0
Actual Paid Professional	0.0	0.0	0.0	0.0
Actual Volunteer	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

Due to funding restrictions a human nutrition research program has not been initiated. However, we are exploring converting some existing Extension personnel into split appointments to establish a research presence in this important field.

2. Brief description of the target audience

-childhood obesity

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific publications and/ presentations

Year	Actual
2011	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Outcomes are still being defined.

Outcome #1

1. **Outcome Measures**

Outcomes are still being defined.

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

Lack of funding to develop this program.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

N/A

Key Items of Evaluation

N/A