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Annual Report of Accomplishments and Results

West Virginia Agricultural and Forestry
Experiment Station

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Davis College of Agriculture, Forestry and Consumer Sciences
West Virginia University

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Introduction

The West Virginia Agricultural and Forestry Experiment Station is administered within the Davis College of Agriculture, Forestry and Consumer Sciences at West Virginia University. The College is relatively broad in academic and research discipline areas, including within the College, Divisions (academic program units equivalent to departments) of Family and Consumer Sciences (includes Child Development, Interior Design, and Textiles and Fashion Merchandising) and Forestry (Forest Resource Management, Wood Science, Parks and Recreation and Wildlife Management) in addition to the more typical Animal and Veterinary Sciences (includes Human Nutrition and Foods recently moved from Family and Consumer Sciences), Plant and Soil Sciences, and Resource Management (agricultural economics, agricultural education and landscape architecture).

The College has approximately 100 full-time faculty to direct research and teaching programs in the College. West Virginia University Extension is administered independently of the Davis College, but Extension and the College have several jointly appointed faculty and conduct a number of integrated programs. The Davis College, WVU Extension, and West Virginia State University will develop a joint plan of work for FY 2007-11, but this report covers only research and integrated, research-extension programs of the Davis College.

The West Virginia Experiment Station supports approximately 35 FTE research faculty positions distributed across about twice this number of individual scientists. The Station also supports approximately 25 FTE technical positions, 35 clerical and farm/forest worker positions and 40 professional support positions (mostly graduate students). The West Virginia Experiment Station operates seven farms and two forests which support faculty research. Four of the farms (Animal and Veterinary Sciences farms in Morgantown and Reedsville, Horticultural and Agronomy farms in Morgantown) and the University Forest are sufficiently close to the University to be used extensively to support academic programs in addition to research. Outlying farms include the Reymann Memorial Farm (beef, sheep, agronomic crops and bull testing station) and Kearneysville Tree Fruit Research Farm (primarily apples and peaches) in northeastern West Virginia; the Willow Bend Farm in the southeast (pasture raised and finished beef cooperative project with ARS); and the Tagart Valley Forest (mostly oak regeneration and disease control research) in east-central West Virginia. All but Tagart Valley Forest serve as extension as well as research centers and, in fact, approximately half the FTE faculty positions at the Kearneysville Farm are Extension appointments.

In addition to competitive, sponsored research, Station faculty participate in approximately 100 formula funded projects (Hatch or McIntire-Stennis), generally including 15 to 20 multi-state research projects. Federal formula funding of about $3 million is slightly more than matched by about $4 million in state support. Faculty also generate an additional $5.5-$6.0 million annually in externally supported research.

The focus of research programs in the West Virginia Station is on economic activities for which West Virginia conditions provide some degree of competitive advantage for state producers, or on problems having impact on families and communities within the state. Examples of the former include proximity to large urban population centers of potential demand for specialty or niche market products; an expanse of exceptional hardwood forests; a topography, soil and climate well suited to the production or forages and/or pasture-reared livestock; a rich history, scenic beauty, abundant wildlife and varied recreational opportunities which are highly attractive to tourists; and extensive water resources well suited to the production of cool and cold water fish for food and recreation. The most common problems impacting families and communities in West Virginia include a state population which is decreasing in size and aging as well due to a disproportionate loss of younger citizens; a largely rural population with limited access to health and nutritional information and a consequent tendency towards poorly balanced, calorie-dense diets; and an extreme need for environmentally friendly and sustainable economic development which will provide jobs to replace the many which have been lost in coal and timber harvesting industries.

A. Planned Programs

Program 1 (National Goal 1): Develop and support globally competitive agricultural and forestry production systems.

Overview

Hardwood forests cover approximately 80% of the state of West Virginia and represent an enormous state resource for the production of timber, for value-added further processing of wood products, and for development of a lucrative tourism industry. Station research is focused on efficient, environmentally friendly, sustainable timber management and harvest (including estimation and maximization of yields), protection of our forest resources from disease and invasive species, the development of unique, innovative uses for timber and value-added wood products, and the optimum use of woodland and wildlife resources to support recreation and tourism.

West Virginia has extensive supplies of rapidly flowing, constant temperature, cool waters which are well suited for the production of cool and cold water fish for food or recreational use. West Virginia also is blessed with numerous ideal settings for sport fishing. Aquaculture research at the West Virginia Station has emphasized the creation and testing of methods to use state water resources (which often flow from abandoned mine sites at heavy volume and near constant 60^{o}F temperature but many, more recently mined, with high mineral content and relatively acetic) in aquaculture production, and on developing a significant fee fishing industry in the state. Specific projects have examined survival, growth and tissue composition of fish reared in treated and untreated mine water; evaluated various rations with respect to rates of gain and feed efficiency; compared different strains of fish for vigor, growth and ultimate size; constructed and tested alternative raceway rearing systems; and surveyed the health status of fish at production facilities throughout the state.

Farmers in West Virginia, and in the Northeast US generally, are poorly positioned to compete in US commodity markets for fruits, vegetables, field crops and livestock products (due to small acreages, dense population, high land and labor prices, etc.). To remain viable, many West Virginia producers must improve efficiency either by increasing the value of what they produce, by producing at significantly lower cost, or both. Specific strategies include reducing costs of major inputs such as feed, increasing real or perceived product value in specialty or niche markets, improving efficiency of reproduction, diversifying product offerings, etc.

Feed costs can represent up to two-thirds of all costs of livestock production. As a result, feed efficiency, or the conversion of feed into body mass, is a major determinant of profitability for meat animal producers. Although considerable variation exists in genetic merit for feed efficiency in populations of beef cattle and sheep, selection for genetic improvement has seldom been attempted due to the considerable difficulty of measuring feed efficiency on sufficiently large numbers of animals. The West Virginia Station recently has installed an electronic system at its Wardensville facility to record feed removals by electronically identified animals and thereby allow efficient and accurate determination of feed efficiency for specific individuals. The electronic system is being used as a component of the annual bull test and will be used in a similar ram testing program in the coming year.

Pasture represents a source of relatively inexpensive livestock feed for many producers in West Virginia. Efficiency of growth and feed utilization for animals maintained on pasture requires adequate quantities of palatable forage. Unfortunately, many forage grasses are colonized symbiotically by endophytic fungi which produce ergot alkaloids toxic to grazing livestock. Maintaining beneficial fungal contributions to the symbiotic relationship while eliminating the toxic alkaloids would be of significant benefit to producers.

Efficient reproduction is prerequisite to profitable production of all livestock species, on pasture or in confinement. Research at the West Virginia Station has focused on neuroendocrine control of ovarian function, follicular development, rupture and persistence, and the role of the uterus in luteolysis in order to develop management programs which increase conception rates, reduce embryonic and fetal mortality, and maintain ideal birth weights in cattle and sheep.

Sheep production is a growing industry in West Virginia which may have significant appeal to many potential producers with under-used pasture resources. The West Virginia Station has provided and continues to provide support to this maturing industry by developing management programs for out of season breeding, financial record keeping, predator control, parasite management and ram breeding soundness determination. A pilot program, adapting the feed efficiency measurement system at the Reymann Memorial Farm to ram testing has been completed. The program will be open to producers in the spring of 2006.

West Virginia's fresh fruit industry (primarily apple and peach) has struggled in recent years with low commodity prices relative to costs of production. Recent research in the West Virginia Station has focused on developing systems for prevention and remediation of disease and insect problems which are less costly to producers, less intrusive to the environment and more acceptable to consumers.

Beef production is among the largest agricultural enterprises in West Virginia, with approximately 13,000 producers statewide. Pasture-based management systems which would carry cattle from birth to market, as opposed to raising feeder cattle to be finished elsewhere, could significantly enhance the competitive position of state producers by using the abundant and inexpensive grassland resources available to many producers. Pasture raised beef research at the West Virginia Station is conducted cooperatively with scientists at Virginia Tech, Clemson University and at the ARS Appalachian Farming Systems Research Center in Beaver, WV. Research has centered on pasture plant species and management, optimum animal stocking rates, enhancing forage intake and digestibility, minimizing supplemental feeding, attaining market weight and condition at reasonable ages, and maintaining carcass quality characteristics of pasture finished beef.

Markets for organically produced food products have increased in volume approximately 20% annually for the last several years and generally are characterized by product prices which are substantially higher than corresponding commodity markets. At the same time, requirements for transitioning to certified organic production are stringent, potentially costly, and lacking sufficient research-based recommended management practices. The West Virginia University Organic Research Project, supported by Hatch funding and the USDA Sustainable Agriculture Research and Education program, was established to develop and test alternative, low cost systems for transitioning from conventional to organic production of vegetables, fruits, field crops and/or livestock. The primary objective is to define practices most environmentally sustainable and economically efficient during the period of transition and early certification.

A focus of the project is on a comparison of systems which transition from conventional to organic production using green manure and cover crops (low input) and those which rely on compost amendments from off-farm sources (high input). Systems are being assessed in market garden vegetable trials (cropped to beans, peas, tomato, pepper, squash, pumpkin, lettuce, and spinach) and in field crop trials (potato, wheat, soybean, Brussels sprouts, and red clover/orchard grass as forage), with and without livestock. Comparisons between systems have involved crop yields; soil organic matter and mineral content; populations of earthworms and nematodes; insect and disease damage; weed infestation levels; and the use of companion crop plantings. Results of this project are being used extensively by producers in transitioning from conventional to organic production. The recent report, *State of the States 2nd Edition: Organic Farming Systems Research at Land Grant Institutions* ranks this project among the five best nationally.

Assessment of Progress

All projects discussed have made, and are making, significant contributions toward enhancing competitiveness of state and regional industries of agriculture and forestry. We are particularly pleased with the maturation of our timber management program, the growth of our wood products research and the increased interest in the Station's organic production research on the part of producers. Producer interest is likewise high in results of the pasture raised and finished beef project conducted jointly with USDA-ARS, Virginia Tech and the University of Georgia. The project has produced pasture-finished beef of excellent quality, indicating the possibility of future transition from producer sales of feeder cattle to sales of finished beef. Evaluation of alternative systems of timber harvest and the ability to accurately predict yields of various products from standing timber will increase economic efficiency and public acceptance of timber harvest while additional uses for value-added wood products can contribute significantly to state economic development.

Expenditures and SY for Program 1 (Goal 1)

Source	$ or SY
Formula	2,171,068
State Funding	2,877,519
SY's (FTE)	19.7

Key Theme 1.1 – Forest Management and Wood Products

a) Description: Research to increase efficiency, profitability and sustainability of forest and timber management; control threats to timber production from insects, diseases, and invasive species; develop innovative hardwood products and structures.

b) Impacts:

A simulation system was developed to estimate productivity, cost, and traffic intensity of different harvesting configurations under a variety of harvesting and stand conditions. Timber stands generated in the simulation were validated by comparison with actual mapped stands. Results indicated our simulation can be used to visualize the structure and composition of hardwood stands and to perform dynamic analyses of various management prescriptions.

Three harvesting systems of chainsaw (CS) /cable skidder (CD), feller-buncher (FB)/grapple skidder (GD), and harvester (HV)/forwarder (FW) were modeled and simulated on five generated stands of different ages in the study. Five harvest methods of clearcut, shelterwood cut, crop tree release cut, diameter limit cut, and selective cut were examined. Simulation results showed that felling production and cost were primarily affected by tree size removed, removal intensity, distance traveled between harvested trees, and felling machines. The feller-buncher was the most cost-effective and productive machine; the harvester was more sensitive to individual tree size. Clearcutting always presented the highest productivity while the shelterwood cut was the least productive method. Unit cost of the harvester was higher than that of the feller-buncher or chainsaw. Extraction operation was sensitive

to payload size, average extraction distance, bunch size, extraction pattern, and extraction machine. The forwarder was the most productive machine under the simulated extraction prescriptions. The cable skidder resulted in a higher unit cost than the grapple skidder or forwarder.

System productivity increased from the chainsaw/cable skidder system to the harvester/forwarder system, and to the feller-buncher/grapple skidder system. The feller-buncher/grapple skidder system could produce 28484 ft3 or 177 thousand board feet (MBF) per week with a unit cost of $27 per 100 cubit feet (cunit) or $44/MBF. For the chainsaw/cable skidder and the harvester/forwarder systems, the weekly production rate was 12146 ft3 (76 MBF) and 16714 ft3 (104 MBF), with a unit cost of $35/cunit ($57/MBF) and $44/cunit ($70 MBF), respectively. TI3 and TI4 are the major concerns since they caused the most soil compaction. The harvester/forwarder system was associated with more unaffected areas while the feller-buncher/grapple skidder system resulted in more affected areas. TI3 and TI4 level was 20% of the total area affected with the harvester/forwarder, 23% with the chainsaw/cable skidder system, and 44% with the feller-buncher/grapple skidder system. A total of 49% of the extraction site was recorded as TI3 and TI4 level for SP1, which was more than two times higher than that recorded for SP5. #

Copper-based biocides have been commercially utilized globally to control wood biodegradation. Although they have demonstrated efficacy in most situations, a number of wood deteriorating fungi are capable of detoxifying copper and have consequently developed tolerance of copper. Our lab has found that, in liquid cultures, copper tolerant fungi, such as Antrodia vaillantii and Aureobasidium pullululans, produce extracellular proteins in the presence and absence of copper sulfate, that both fungi produced only one organic acid, oxalic acid, which varied between the two species in production and concentration, and that in the presence of copper sulfate in liquid cultures, copper oxalate crystals were found on the fungal myceliae. It has been shown that some microorganisms produce extracellular proteins during growth which serve as chelators of metal ions and may be involved in the metal tolerance mechanism.

Our current objective is to determine if these fungi can produce organic acids and proteins when grown on wood in the presence and absence of copper sulfate. The sapwood of two wood species, southern pine (softwood, gymnosperm) and yellow poplar (hardwood, angiosperm) were used. Thin wafers of the two wood species were used and each species was separated into three groups. Two groups were treated with two levels of copper sulfate solution and placed on glass rods set in a glass tray and allowed to dry at room temperature for two weeks. Un-treated wood wafers served as control. Two fungal species, Antrodia vaillantii and Aureobasium pullulans, were used. The A. vaillantii was obtained from the Forest Products Laboratory, Madison, WI and the A. pullulans was isolated from red cedar shingles in Morgantown. Both species were initially cultured in 2% (by weight) malt liquid cultures for two weeks, harvested aseptically by filtering and washing off the liquid culture media, and aseptically blending each fungal filtrate in sterile deionized water containing 0.005%

detergent. Both copper sulfate solution-treated and un-treated wood wafers were sterilized and inoculated with sterile blended culture of each fungal species by dipping the wood wafers in 2500 mls of blended fungal culture for 10 minutes and placing them in sterizable plastic bags with side-breathable ports. There were two controls, un-treated, un-inoculated wood wafers and un-treated, inoculated wood wafers. These were incubated at 20 0C and 93% relative humidity for three months. At the end of the incubation period, the wafers were harvested and their extracellular proteins and organic acid contents extracted. Treated and un-treated inoculated and non-inoculated wafers currently are being extracted. The filtrates will be concentrated and analyzed for both proteins and organic acids.#

Research on oak diseases has expanded to include sudden oak death. Although not yet a problem outside the Pacific Coast states, an evaluation of the potential for the causal pathogen to establish in the Appalachians is necessary. Current studies are designed to identify and establish the role that close relatives of the sudden oak death organism play in eastern forest ecosystems. Primary focus is the genus Phytophthora and its relatives as inhabitants of soil and aerial environments. In the spring and fall 2004, a survey of oak forests was conducted in nine states IL, IN, MD, MI, MI, PA, OH, WV and WI. Rhizosphere soil samples taken from around the base of healthy and declining oak trees were baited with Quercus robur leaflets and portions of colonized leaves were plated after 3-to-5 days on PARPNH- medium. Phytophthora cinnamomi was the most frequently isolated species representing 73.6% of all isolates recovered. Other species included P. citricola (5.2%), P. europaea (7.5%), P. cambivora (4%), and P. quercina-like (2.3%).

Two other undescribed Phytophthora species were discovered; one represented 7.5% of all isolates and 16.7% of infested sites. Phytophthoras were associated with 11 different oak species, and were isolated from sites with soil pH that ranged of 3.2 to 7.1. In total, 133 sites were surveyed with 54.1% of sites yielding at least one Phytophthora species. Twenty-one percent of 820 soil samples were positive for Phytophthora. These results suggest that numerous Phytophthora species are common to oak forest soils. Stem inoculation of 2-year-old plants resulted in P. cinnamomi being the most aggressive Phytophthora species tested on all oak species. P. cinnamomi and P. citricola caused the largest lesions extending up to 170 cm on stem inoculation tests of 20 yr-old-red oak trees in the field within the two months of inoculation period. Other recovered Phytophthora species also were able to cause significant lesions compared to control treatment with exception of the P. quercina-like isolate.#

Chestnut blight has devastated Chestnut forests in North America yet natural, biological control of the disease by hypoviruses is known to occur in several locations. Field trials and laboratory tests are designed to determine and understand the mechanisms by which these hypoviruses become established and are spread. Disease progress, spread of two hypoviruses and evaluation of host responses continues at a West Salem, WI American chestnut stand. Canker treatments with hypovirus-laden inoculum were made from 1992-1997 and were resumed in 2002-

2005 after analyses demonstrated that hypovirus spread occurred principally on trees that received treatment inoculum. In 2005, 628 cankers were sampled in 12 permanent plots. Year-to-year trends indicate that hypoviruses persist very well on trees where they are introduced by canker treatment but spread poorly to cankers on adjacent, untreated trees. Hypovirus treatment has prolonged the life of treated trees when compared to non-treated trees.

A second study in WV was initiated in 2004 to evaluate the biological control potential of C. parasitica strains containing an infectious cDNA copy of the CHV1-Euro7 hypovirus (transgenic). This study compares inoculum production, sexual reproduction and dissemination of cytoplasmic and transgenic isolates and is designed to evaluate whether transgenic C. parasitica strains containing a cDNA transgene encoding the viral genome of CHV1-Euro7 show greater potential to biologically control blight than their cytoplasmically infected counterparts. Three treatments were employed to compare transgenic hypovirulent strains (TG), cytoplasmic hypovirulent strains (CH), and virulent strains (V). To produce ascospore inoculum, naturally occurring and artificially established cankers were spermatized by painting cankers in June, July, and September with a conidial mixture that contained both mating types (MAT-1 and MAT-2) of the appropriate treatment strain (TG, CH, or V). To produce conidial inoculum, cankers were surface-initiated (SI) on separate trees in June 2004 by scratching the bark and painting the wounded area with a slurry of the appropriate treatment strain (TG, CH, or V). Non-treated trees also were left to monitor natural canker formation. Most trees were asymptomatic after the first treatment season and the incidence of natural infection remained relatively low. In the fall of 2004 and 2005, cankers were sampled to determine the hypovirus infection status of the thallus. Although the purpose of the spermatization treatment was to produce ascospores, many treated cankers also acquired hypovirus from the treatment inoculum. Ascospore production was assessed by collecting bark discs in October 2004 and serially diluting ascospore contents from perithecia. Hypovirulent ascospore (HVA) isolates were collected only from TG plots and at less than expected Mendelian ratios. Pigmentation segregated as expected in V and CH plots. The transgenic MAT-1 treatment strain effectively spermatized and produced HVAs on both initiated cankers and treated natural infections. To assess the increased conversion capability of HVAs, 18 HVA isolates were paired with 17 vegetative compatibility (v-c) types isolated from the study site; pairings were examined for hypovirus transmission. Collectively, HVA isolates were able to convert 15 of the 17 v-c types. Overall, the production of HVAs with different conversion capabilities increased the biological control potential of transgenic strains.#

The need to evaluate strength and stiffness of structural wood and wood based materials that have been in service for many years is increasingly common. In retrofitting aging structures, non-destructive evaluations of residual strength and stiffness of built-in structural elements have exceptional importance. Furthermore, the field performance of newly developed structural composites needs to be monitored, to provide information for further improvements in design, construction, and manufacture. To assess the durability and disaster resistance of existing and new

structures also requires the evaluation of mechanical properties of structural materials. This research investigated non-destructive (NDT) methodologies for evaluating the modulus of rupture (MOR) and modulus of elasticity (MOE) of built-in structural lumbers and composite products. Methods included stress wave timing for dynamic MOE determination and screw withdrawal measurements using a portable, field-measuring device. Standard ASTM testing procedures determined further mechanical and physical properties such as MOR, apparent/true MOE, density, and moisture content. Statistical relationships between these variables were identified and simple prediction models were developed to estimate design properties. Materials involved in the analyses included red oak, yellow-poplar, spruce-pine-fir, and Southern yellow pine lumbers. Furthermore, laminated veneer umber (LVL) and parallel strand lumber (PSL) were also tested and analyzed. Results indicate that stress wave timing is a good tool for evaluating actual MOE of the materials. However, it requires proper moisture content determination. The screw withdrawal resistance is a good indicator of density and, combined with the dynamic MOE, a reasonably accurate estimation of MOR can be achieved.#

c) Funding: Hatch, State and special research grant.

d) Scope of impact: Integrated research and extension

Key Theme 1.2 – Aquaculture

a) Description: Assess potential and develop optimum economic and environmental production practices and provide support for the establishment and success of food and recreational fish production enterprises.

b) Impacts:
Two commercial diets were evaluated for production of Rainbow Trout (RBT) in Treated Mine Water. One diet was made with fish meal (FM) and the other was fish meal free (FMF). 8,000 RBT were fed daily to satiation. Water quality, fish productivity, and solid waste data were collected on a monthly basis. Fish fed FM diet grew nominally better, had better feed conversion and fewer mortalities. The FMF diet produced a smaller quantity of solids and proportionately less pollutants, on average throughout the study. The pollutant load to the receiving stream, was more than 50% greater for the segments treated with the FM diet than the pollutant load from segments fed the FMF diet. #

An experimental system which allows examination of the interaction between water velocity, plant density and culture medium on the nutrient removal capacity and growth dynamics of watercress was constructed. Preliminary results indicate that a simple paper towel support medium was a better culture medium than standard horticultural culture media (oasis cubes or rock wool). Light conditions within the raceway building were substantially less than expected and resulted in etiolated plants. Subsequent experiments will be carried out in a greenhouse which will provide a more favorable light environment. #

A software program was developed to assist in the design of new raceway systems or to evaluate the operation of an existing raceway. The Excel worksheet performs calculations for a single tank in the raceway system using user-defined inputs. #

A raceway system was stocked with 6000 fingerling RBT in October, 2003 and harvested in June. Half of the fish were fed a traditional fish meal based diet and half a commercially available fish meal free diet. Water quality, fish production, and solid waste data were collected. There were marked differences in the character of sludge produced from the different feeds. #

Production and metabolic variables from 4 families of rainbow trout were measured. These 4 families comprise two strains from which high feed efficiency and low feed efficiency families have been identified. Fish were or were not under metabolic/ nutritional stress and response in lysine metabolism were measured. Families within strain that were most efficient at one point in there growth curve were not necessarily more efficient through out their growth curves. Data also suggested that the regulation of lysine catabolism occurred post-translationally. #

Hybrid striped bass (HSB) were stocked to compliment hybrid bluegills at three study sites. HSB fishing opportunities were evaluated as part of different recreation program formats. On-site observations and questionnaires were used to evaluate the success of this stocking project. HSB were hard hitting and aggressive when first stocked, but later became hook shy. The average respondent caught 1 HSB per hour. Over 80 percent of participants were willing to pay $10 per child. #

A major constraint to increasing production efficiency of the Nation's cool and cold water aquaculture industries is the lack of genetically improved strains of fish for specific production systems. In a cooperative project with USDA/ARS National Cool and Cold Water Center for Aquaculture (NCCCWA), scientists at the West Virginia Experiment Station are using functional genomic and molecular biology technologies to identify genes that regulate traits of economic importance (reproduction, growth, feed efficiency, disease resistance, etc.) in cool and cold water fish.

Current focus is on identifying genes that are important in regulating early embryonic development in rainbow trout using a microarray platform containing *in situ* synthesized 60-mer oligonucleotides representing unique transcripts derived from oocytes and embryos. A normalized cDNA library was constructed from oocytes and 20,160 ESTs were generated and approximately 60,000 ESTs were identified from three cDNA libraries. In addition, a subtracted rainbow trout embryo library was constructed with approximately 5,000 random clones sequenced. More than 10,000 unique oocyte-expressed sequences have been identified and annotated while more than 5,000 sequences have been generated from the subtracted embryo library. These sequences provide a global picture of genes expression in trout oocyte and embryo and are important to identify key genes essential for oocyte development, maturation and embryogenesis. #

c) Funding: Hatch, State and special grant research

e) Scope of Impact: Integrated research and extension.

Key Theme 1.3 – Agricultural and Forest Profitability

a) Description: Support state economic development of agriculture and forest industries with a focus on activities offering competitive advantage to state producers.

b) Impacts:

The Reymann Memorial Experimental Farm in Wardensville, WV has used an electronic feed monitoring system to record individual feed intake and compute feed efficiency on consecutive classes of bulls submitted to the annual West Virginia Bull Test. The system also has been used with cow-calf pairs to determine the effect of cow age, cow body condition and sex of calf on feed intake, weight gain and feed efficiency, and will be used to test feed efficiency in rams next Spring.

To date, approximately 275 beef bulls have been evaluated for feed efficiency with sufficient variation found to provide a choice to both buyers and breeders of bulls. Although results are limited to only two years, buyers paid about 5% more for bulls evaluated at or above average for feed efficiency, with evidence to suggest this premium is increasing. #

A pilot trial of adaptation of the feed efficiency system used for bulls at Reymann Memorial Farms in Wardensville was carried out with 37 University-owned ram lambs in late spring and summer, 2005. The trial showed a clear difference in the feed efficiency of rams, nearly 100 lbs. less feed required by the most efficient ram than by the least efficient ram over the 60-day trial. The most efficient ram will save a sheep producer about $12.00 as compared to the least efficient ram. Feed efficiency is a moderate to highly heritable trait, so given the variability among ram lambs, a great deal of genetic improvement can be made. A comprehensive Flock Record Program, developed over the past three years, and tested by County Extension Agents is ready for implementation in farm flocks. The implementation will require hands on guidance of the farmers by Sheep Improvement Project personnel and is integral to being able to test ram lambs at a central Station (Wardensville). The goal for 2006 is to enroll at least 50 current and new cooperators of the Sheep Improvement Project in this program. Records from either this program or the National Sheep Improvement Program will be required for entering ram lambs into the central test station, which will be opened to the producers in spring 2006. #

A study of the effect of feed particle size and texture on broiler performance has shown medium to course particle corn (1,042 to 2,242 microns) improved ingredient digestion while broilers fed course particle corn (2,242 microns) demonstrated increased gizzard growth and perceived maintenance requirements that compromised performance. Digestive benefits may have been due to decreased feed passage time for the medium to coarse particle size. Additionally, broilers fed pellets of hard

texture demonstrated improved nutrient retention and subsequent performance relative to broilers fed pellets of soft texture (1,856 and 1,662 g of pellet breaking force respectively). #

The identification of genes required for ergot alkaloid production was pursued during the initial months of this project. A catalase-encoding gene that is common to the ergot alkaloid gene clusters of Aspergillus fumigatus, Claviceps purpurea, and Claviceps fusiformis, was inactivated by gene knock out in A. fumigatus. Three knockout mutants were identified by PCR analysis and were found to be free of ergot alkaloids by HPLC analysis. The block in the pathway was determined to be prior the intermediate chanoclavine by in vitro feeding studies. In these studies, chanoclavine was fed to broth-based cultures of the fungus, and the cultures were tested for ergot alkaloids forty hours after supplementation with chanoclavine. The catalase knockout cultures that were supplemented with chanoclavine produced festuclavine and fumigaclavines A and B, whereas unsupplemented cultures produced none of these ergot alkaloids. Chanoclavine also was converted into festuclavine and fumigaclavines by the dmaW knockout mutant that we reported previously. This strain served as a positive control, since it is blocked in the first step of the pathway, well before chanoclavine. The restoration of ergot alkaloid production in the catalase knockout by supplementation with chanoclavine suggests that the catalase has a biosynthetic rather than protective role during ergot alkaloid synthesis.

In a separate study, the restriction of ergot alkaloids to conidia (asexual propagules) as opposed to hyphae (the vegetative thallus) of A. fumigatus was indicated by generation and analysis of a knockout mutation in the bristle A (brlA) gene. The brlA gene was cloned based on sequence similarity to the well-characterized orthologue in Aspergillus nidulans. Knockout of brlA in A. fumigatus resulted in a nonsporulating mutant phenotype similar to that reported for brlA-deficient A. nidulans. The nonsporulating brlA knockout strain produced no ergot alkaloids when cultured under any of several conditions that are conducive to ergot alkaloid production in wild-type A. fumigatus. The data indicate that ergot alkaloids are produced only in conidia (or in conidiating cultures) of A. fumigatus. Prerequisite steps for additional truncations of the ergot alkaloid pathway were taken by construction of knockout plasmids for three more genes that are shared among the A. fumigatus, C. purpurea, and C. fusiformis clusters.#

Many ergot alkaloids are known to be toxic to animals but some may be necessary to maintain desirable agronomic properties of endophyte-infected grasses. Perennial ryegrass-endophytic fungus [Neotyphodium sp. Lp1 (Neotyphodium lolii x Epichloe typhina)] associations with altered ergot alkaloid profiles were fed to rabbits to ascertain effects of ergot alkaloids on preference and satiety. Grass symbiotic with endophyte containing a knockout in the lysergyl peptide synthetase 1-encoding gene (lpsA) accumulated clavine ergot alkaloids in leaf blades but no ergovaline or simple amides of lysergic acid. Perennial ryegrass containing endophyte with a knockout mutation in the dimethylallyl-tryptophan synthase gene (dmaW) accumulated no ergot alkaloids. Endophyte-free plants lacked ergot alkaloids and endophytic fungus,

whereas plants symbiotic with the wild-type endophyte produced a full spectrum of ergot alkaloids including clavines, ergovaline, and the simple amides of lysergic acid, ergine.

In paired tests, rabbits preferred plants that were endophyte-infected but free of ergot alkaloids (i.e., dmaW knockout) over endophyte-free plants (P = 0.01). Accumulation of clavine ergot alkaloids (as in the case of the lpsA knockout), or clavine alkaloids plus ergovaline and ergine (as in the case of wild type), counteracted the appeal of endophyte-infected plants. Since clavine alkaloids alone reduced the appeal of endophyte-infected grass, ergovaline and ergine may either be redundant with respect to reducing appeal of the grass or not significant for this particular role. In satiety tests, consumption of ergot alkaloids during an initial meal of grass had a negative effect on subsequent rabbit chow consumption. The data indicate that ergot alkaloids may deter herbivores by reducing the appeal of endophyte-infected grasses and by reducing appetite.

The effects of these same knockout mutations on seed transmission was investigated, and seed transmission of endophyte was very efficient (100% transmission) in control and both dmaW and lpsA knockout symbiota. The data indicate that elimination of lysergic acid derivatives or all ergot alkaloids does not affect vertical transmission of the endophyte. Additional pathway truncations have been initiated in Aspergillus fumigatus, to assign biochemical functions to remaining genes in the ergot alkaloid cluster. Results to date indicate that removal of ergot alkaloids does not compromise resistance of the host grass to plant-parasitic nematodes. Results also indicate that removal of ergot alkaloids makes endophyte-infected grass more appealing to herbivores. This may promote feed intake by grazing animals in the short term but also may affect longevity of stands. #

Ultrasonic monitoring of the expansion of the allantois has been used to study factors affecting late embryonic mortality in beef cows. Studies of the endothelin system in early and mid-luteal phase CL have continued as well. We have shown that the epsilon isozyme of protein kinase C (PKC) is present exclusively in steroidogenic cells in the CL, is expressed highly and is activated by endothelin-1 in day-10 CL. This PKC isoform may play an important regulatory role in decreasing progesterone during luteal regression. If the reduced progesterone in some cows during the late embryonic period is due to changes in luteal function (as opposed to changes in metabolism of progesterone), PKC epsilon may play a role in those changes. This possibility will be determined in the samples currently being collected.#

Low birth weight is a major cause of perinatal losses in livestock, particularly in sheep. In fact, 20% of all lambs die before weaning; 80% of those deaths occur during the first few days of life. Furthermore, growth and development is altered in low-birth-weight lambs, which is manifested by slower growth, lower nitrogen and fat accretion and a reduced growth of the skeletal system. The goal of this project was to understand how alterations in the environment that the embryo is exposed to very early in gestation impacts later development, both before and after birth. To

accomplish this we established an experimental paradigm to generate animals with markedly different uterine environments during the first few weeks of gestation. Ewes were treated with a sustained release formulation of growth hormone immediately prior to breeding. This treatment resulted in a 5-fold increase in the uterine luminal content of IGF-1 (a growth factor that stimulates embryo development). By the middle of gestation conceptuses that were gestated by ewes that received the growth hormone treatment had fetuses that were similar in size to conceptuses gestated by control treated ewes. However, the placentas of coneputses gestated by ewes treated with growth hormone were only one-third the size of those gestated by control ewes. As a result, the efficiency (fetal weight/placental weight; an indication of relative placental function) of placentas gestated in ewes treated with growth hormone was more than doubled. As an apparent result of this increased relative function of the placenta, lambs born to growth hormone treated ewes weighed approximately 500 grams more than lambs born to control ewes. Furthermore, lambs that were born to growth hormone treated ewes that were reared as singletons maintained that advantage in weight through 75 days of age. #

Effects of seminal plasma (SP), TGF-beta-1 in bovine serum albumin (BSA), placed in the uterine lumen at onset of estrus on conception rates (CR) were tested in cows bred AI 12 h later with frozen semen. Pregnancy was determined 30 d post-breeding. In trial 1, CR's were 61% in control, 71% in cows treated with TGF-beta-1, and 78% in cows treated with SP. In trial 2 with cows of varying ages on 5 farms, CR's were 58% in controls, 45% in TGF-beta-1-treated cows, and 54% in SP-treated cows. Age x treatment x type of estrous synchronization tended to affect CR (p=.09). In trial 3, CR of heifers receiving SP or control did not differ. #

Transforming growth factor-1 (TGFb-1) has an anti-inflammatory effect in the uterus after insemination in mice and human beings. TGFb-1 might play a role in induction of tolerance to fetus. Decorin, an extracellular matrix proteoglycan, binds TGFb-1, possibly storing it. In experiment 1, distributions of free TGF-b1, TGF-b2, TGF-b3, TGFbRI and TGFbRII, decorin and TGF-b isoforms bound to decorin were examined in sheep uterine tissue at estrus, fertilization and early pregnancy. Ewes were synchronized for estrus (progesterone vaginal inserts), mated, and assigned at random to 4 groups (day 0-day of breeding, day 2-post fertilization, day 4-embryo entering the uterus, and day 6-blastocyst development). Ewes were anesthetized and ovario-hysterectomized (n = 4 each day), and tissues were sectioned (10 mm wide) and quick frozen in isopenthane chilled by liquid nitrogen, fixed by formalin and 70% ethanol, processed, and embedded in paraffin. Immunohistochemistry was used to localize TGF-b1, TGF-b1 receptor (TGFbRII), and decorin.

Strongest TGF b-1 staining was on D0 in epithelial endometrial cells, in endometrial glands close to the lumen, and in endothelial cells in myometrium. Phagocytic cells as well as fibroblasts were positive for TGFb-1. TGFbRII was mostly in muscular layer of blood vessels in myometrium, on phagocytic cells, and some epithelial cells of deep uterine glands. Decorin was in serosa, extracellular space surrounding myofibrils in myometrium, and in tunica adventitia. Presence of TGFb-1, its receptor,

and binding proteoglycan, decorin, in specific compartments of sheep uterus was demonstrated. TGFb1 in serum, uterine tissue, and uterine flushings were measured in Experiment 2. Blood samples were collected before surgery, and uteri were flushed immediately after excision. Average total (including active and latent form) concentration (ng/ml) of TGF-b1 in serum was 33.2+/-4.6 at D0, 21.8+/-3.9 on D2, 18.6+/-5 on D4, and 23.5+/-4.2 on D6 ($p>0.05$). Concentrations (pg/ml) of active TGF-b1 were 197.5+/-37 on D0, 128.4+/-18.6 on D2, 133.1+/-19.2 on D4, and 131.5+/-37 on D6. TGFb-1 concentrations (pg/ml) in uterine tissues and fluid were determined by enzyme-linked immunosorbent assay (ELISA).

Values in tissue did not differ between days (1278+/-141 pg/gm). In luminal fluid, concentration of latent TGFb-1 varied by day ($p=0.01$) and by progesterone (RIA) concentration ($p=0.006$). Highest concentration of latent TGFb-1 was on D2 (1006+/-384) and lowest on D6 (249+/-168). Concentration of active TGFb-1 was not significantly different but ranged from a high on D4 (333+/-45) to a low on D6 (102+/-51). TGFb-1 presence in uterine fluid after D2 suggests uterine, as opposed to seminal plasma, origin. This proposition is supported by concentration of TGFb-1 in seminal plasma of the rams being lower than that in the uterus (< than 894 pg/ml). Uterine secretion could be dependent on presence of seminal plasma components and/or sperm after mating. Experiment 3 is being conducted to examine effects of mating on uterine secretion of TGFb-1. #

To determine if embryonic loss in cows that ovulate persistent follicles might be due to changes in RNA in the oocyte, cows were assigned to 4 groups with growing follicles harvested on d 6 (G6) or d 8 (G8) and persistent follicles harvested on d 13 (P13) or d 15 (P15), following superstimulation with FSH on d 1 to 4 of the estrous cycle. Cows in 3 groups received PGF2alpha on d 6; ovaries in the 4th group (G6) were harvested on d 6. Cows in P groups received progesterone on d 5 to 13. Oocytes were aspirated after ovariectomy, denuded of cumulus and stored at -80 C until isolation, purification and amplification of RNA. Expression ($p<.05$) differed between G and P for MSY2 and PARN and between days for YY1 and PARN.

In order to determine whether induced variation in luteal phase progesterone can influence litter size, mature ewes were treated to have low, medium or high progesterone (n= 56 per group). Each ewe in low and high groups received a progesterone intravaginal insert from d 4 to 14 after estrus. Ewes in the low group were given PGF2alpha on d 6 to regress corpora lutea (CL). On d 7, six fertile Barbados Blackbelly rams were introduced to 6 pens of 10 to 16 ewes. Numbers of follicles that disappeared ($P<0.02$) and numbers of CL formed ($P<.01$) increased linearly with decreasing progesterone. Conception rates did not differ with treatment. Lambs born per CL decreased linearly ($P<.01$) with decreasing progesterone. Thus prolificacy did not differ among ewes with low (2.0), medium (1.9) or high (1.9) progesterone. Lower progesterone increased ovulation rates, but not lambs born per ewe lambing. In bovine CL, abundance of PKC epsilon mRNA increased from d1 to 10 and remained stable on d17. PKC epsilon was found exclusively in steroidogenic cells (SC), both large and small, whereas PKC alpha, beta-1 and beta-2 were

expressed in SC and in endothelial cells. Endothelin-1 stimulated cellular redistribution of PKC alpha, beta-1 and beta-2 into the membrane fraction in d-10 CL, PKC epsilon having been only in cytosol before treatment. By ultrasonography, the allantois was detected 1.2 d earlier (P<.05) in heifers than in lactating cows. Diameter of the allantoic lumen (4.6 mm) did not differ with d of detection or age of dam. Length of embryo (range 2.6 to 7.9 mm) varied with d of detection (P<.05), but not age of dam. Differences might indicate an asynchrony in development of embryo and placental membranes. #

In an effort to enhance the attractiveness of traps for monitoring stink bugs, a study utilizing baited pyramid traps was conducted in a commercial apple orchard in Hampshire County, WV. Yellow plastic pyramid traps of 0.61 m in height were fitted with a 3.8 L plastic jar top and provisioned with either an aggregation pheromone lure [methyl (2E,4Z)-decadienoate], an apple volatile lure, or a combination of both lures. All traps were provisioned with 1/4 piece of insecticide ear tag, which was replaced along with lures every 4 weeks. Traps were installed on May 18 to horizontal branches of apple trees in the border row adjacent to a woods and checked weekly until October 13 (21 weeks). For all baited trap treatments, brown stink bug was the most abundant species captured, followed by dusky stink bug and green stink bug. Captures were highest in traps baited with the aggregation pheromone lure, followed by the combination of aggregation pheromone and apple volatile lures, with very few captures in traps baited with the apple volatile lure alone.

In a second experiment, brown stink bug response to pheromone was evaluated by monitoring populations in traps and on surrounding rings of potted mullein plants. Yellow plywood pyramid traps of 1.22 m in height were fitted with a 3.8 L plastic jar top and baited with aggregation pheromone, or left unbaited. Three replications of each trap type were installed on the ground 80 m apart in a large open field. Pyramid traps were surrounded by 3 rings of 4 mullein plants each at distances of 2, 10 and 20 m from the trap. Incidence of brown stink bugs in traps and on mullein plants was determined for 6 days from July 19-24. Brown stink bugs were more abundant in baited than in unbaited pyramid traps, and on mullein plants surrounding baited than unbaited traps. In plots with baited traps, stink bugs were most abundant on the closest (2 m) ring of mullein plants, with a decline in abundance with increasing distance from the traps. In plots with unbaited traps, stink bugs were most abundant on mullein plants at 10 m, with fewer and similar numbers on mullein plants at 2 and 20 m distance from the traps. Females were more abundant than males in traps and on mullein plants.

In a third experiment, various insecticide treatments were evaluated for stink bug control in a peach orchard. Four applications of a combination of Warrior plus Imidan resulted in a lower level of catfacing/scarring and gummosis/watersoaked injuries to fruit than four applications of a combination of Asana plus Imidan applied during the mid to late season.#

c) Source of Funding: Hatch, State.

d) Scope of Impact: Integrated research and extension.

Key Theme 1.4 – Pasture Raised and Finished Beef

a) Description: Cooperative project with USDA ARS Appalachian Farming Systems Research Center, College of Agriculture and Life Sciences, Virginia Tech, and College of Agriculture and Environmental Sciences, University of Georgia, to develop and implement beef cattle, birth-to-market production systems capitalizing on low-cost, Appalachian grasslands as a major production input.

b) Impacts:
Year-one of winter, stocker-steer grazing commenced in early December (12/2) 2004 and concluded in early April (4/4) 2005. The overall goal for this project from an animal performance perspective is to achieve a 1-lb/day average gain over the winter grazing season on a forage-based program. Steers were randomly allotted to one of four treatments (Native, Orchardgrass haylage (OG haylage), Orchardgrass hay (OG hay), or Tall fescue). Within each of these treatments steers were stocked at equal stocking densities and allowed to graze respective namesake stockpiled forages. Upon substantial snowfall that would limit grazing and/or upon complete removal of grazable forage, steers in the Native, OG haylage and tall fescue treatments were fed first cutting wrapped orchardgrass/red clover haylage while those on the OG hay treatment were removed from the pasture and fed dry first cutting orchardgrass/red clover hay.

All treatments except for tall fescue were falling short of our gain goal by the end of January and were started on soybean hull supplementation in early February at a rate of 20% of their expected dry matter intake (2% of body weight). At the conclusion, tall fescue steers came close to our proposed goal (0.97 lb/d) while Native, OG haylage and OG hay steers fell well short (0.71, 0.62, 0.48 lb/d, respectively) even with additional supplemental feed. These steers are part of a larger project encompassing multiple institutions and locations and had previously been housed at facilities at Virginia Tech and as one would expect experienced body weight shrink during transport to our facilities. This shrink was not considered in the proposed weight gain. If shrink were considered for a systems approach, all animals fell well below 1-lb/d gain through the winter. Due to yearly variation and body weight shrink this study is being repeated and began early December 2005. Gains from the first 28 days on test and considering previous body weight shrink, OG hay, OG haylage, and tall fescue steers are gaining 1.19, 1.08, and 1.00 lb/d respectively on grazable forage alone. Native treatment steers are slightly below at 0.90 lb/d and were started on soybean hull supplementation at 1.0 lb/hd/d beginning 1/19/06. Several intrinsic forage components were tested as potential intake markers. None showed promise in the determination of intake by forage fed cattle. All showed potential within a given forage species. #

To conduct a comprehensive economic analysis of pasture-raised beef production, it is necessary to examine both the supply/production side and the demand side. Thus,

both firm-level and market-level analyses are necessary. Such analyses will facilitate estimation of enterprise profitability and economic risk within the industry and market context in which decisions are made, and provide valuable information for the beef industry and for policy makers concerning the ultimate success of Appalachian pasture-raised beef in the retail arena. This is especially important given that pasture-raised beef is currently a niche or specialty product with limited knowledge about its true profitability, risk, and market potential. To date, the following analysis has been completed:

A comparative stochastic budgeting analysis for pasture-raised beef (PRB) and traditional production and marketing in which PRB products were assumed to be directly marketed to local consumers and traditional producers were assumed to sell live cattle on the commercial market following one of several retention periods. Cut-by-cut revenues for PRB producers were conservatively estimated using retail beef scanner prices; animal and pasture performance and input requirements were allowed to vary over multiple iterations. Higher potential profits and less risk of economic loss were consistently associated with PRB production, even in seasons of poor animal and pasture performance.

The following work is proposed to complete the above analysis:

Updating and recalibrating the budgets based on results from ongoing experiments at various locations around the study area. The updated analysis should provide better measures of yield, cost, and revenue variability. We plan to subsequently use this information to develop a web-based, decision-support tool that can be used by individual producers to estimate their potential costs and returns from alternative PRB production and marketing strategies.

Regression analysis of an extensive live cattle price data set that will facilitate a better understanding of the economic returns possible from marketing live cattle and will be used for comparative purposes in determining economically optimal production and marketing strategies for individual producers.

To complement the work done regarding the uncertainties in the *production* realm and as an essential component of a market analysis, the following is proposed as a new initiative:

> An assessment of consumer perceptions of *and* willingness to pay for Appalachian pasture-raised beef, relative to commoditized grain-fed products, using experimental economics methods. Specifically, valuations will be obtained in either experimental auction or in-store settings and will be modeled as functions of product attributes and consumer demographics so as to inform marketing and labeling decisions. Information obtained here will ultimately be used in concert with production cost estimations to obtain more accurate predictions of profitability and economic risk. # <<<

c) Funding: Hatch, State and Special Research Grant

d) Scope of Impact: Multi-state integrated research and extension
CA-B, CA-O, CO, CT-NH, FL, GA, IN, KS, MA, MD, MN, NV, NY-G, NY-I, OR, PA, RI, SD, UT, VA, WA, WI, USDA

Key Theme 1.5 – Organic Production Systems

a) Description: Compare alternative systems of conversion from conventional to organic production of vegetables, field crops and/or livestock products; determine practices most environmentally sustainable and economically efficient during periods of transition and early certification.

b) Impacts:
Low-input organic farming systems using green manure and cover crops were compared to High-input systems that include 10 T/acre dairy manure compost amendments from off-farm sources. Systems were assessed in a market garden vegetable trial and a field crop/livestock trial at the WVU Horticultural Research Farm which was certified organic in 2003. The field crop trial included with- and without-livestock (sheep) treatments, arranged in a factorial randomized block design with the 2 compost (High vs Low-input) treatments. Soil and plant samples were analyzed and pests were monitored and controlled uniformly on all treatments following organic standards. Small-plot trials evaluated compost rates, pest management, and variety evaluations to optimize yields and reduce insect and disease problems.

High input plots showed higher yields than low input plots in tomato, pepper, lettuce, spinach, green beans, squash, and pumpkin, but not peas, which yielded higher in low input plots. Organic matter levels were significantly higher in the high input than the low input treatments and increased from year to year in both treatments. Available phosphorus levels in the high input treatment plots were excessive, while potassium levels were excessive in both treatments. Root rot of spinach was significantly lower in plots with compost. In field crops, potato, wheat and hay yields were also greater in high input treatments. Sheep produced healthy lambs which gained faster on plots with versus without compost. Greater forage production occurred on pasture plots with compost, allowing a higher stocking rate, producing more total gain per acre for lambs. Soil organic matter, phosphorus, potassium, and magnesium were increased in plots with annual compost application, but increases in soil fertility and quality occur slowly. Earthworm populations and biomass tended to be higher in plots receiving compost but differences were not always statistically significant over the six years of these experiments.

In trials evaluating insect biological control, a parasitic wasp gave excellent control of the Mexican bean beetle, resulting in significantly higher yields of green beans, especially at the end of the season. Floating row cover also provided some protection, but warm rainy conditions resulted in some leaf damage. Varietal responses to

Mexican bean beetles were also compared. Data analyses from field and greenhouse trials to evaluate compost tea for suppression of early blight on tomato showed that the tea had no consistent effect on disease severity. Plots where the soil was amended with compost from dairy manure had significantly less disease than plots with compost from yard waste. Yield differences between compost treatments were not statistically significant. Trials to evaluate organic management practices for seed rots, weed management, management of intestinal parasites in sheep, and poultry production are planned for 2006. Additional work will evaluate methods to extend the growing season using high tunnels. #

A large farming systems trial, begun in 1999 to evaluate transition methods for conversion from conventional to organic farming practices, was continued through 2005. A vegetable crop trial and a field crop trial evaluated a high input, compost-intensive management system versus a low-input system that relies on green manures and cover crops. High input treatments received 10 tons/acre of composted dairy manure annually. Cover crops were planted and plowed in as green manures in low input plots. Soil samples were analyzed for plant-parasitic and predatory nematodes, and assayed for nematode biocontrol agent activity. Pratylenchus crenatus, Xiphinema rivesi, Helicotylenchus spp., Tylenchorhynchus spp. Meloidogyne hapla, and Clarkus papillatus (predator) were the most common nematodes present. Population densities remained low for all plant parasites throughout this experiment and differences among compost treatments or crops were not statistically significant, suggesting the presence of suppressive soils. Predatory nematode population densities were also low, but were significantly higher in plots with compost than plots without. Bacterial feeding nematodes tended to increase over the four years of the trial, but compost treatments did not differ. Data analyses continued on experiments assessing nematode suppression by endophyte infected fescue and in trials to evaluate biocontrol potential of the predatory nematode, Clarkus papillatus. #

c) Funding: Hatch, State

d) Scope of Impact: Integrated research and extension

Program 2 (National Goal 2 and 3): Ensure a healthy, well-nourished population with access to a safe and secure food system.

Overview

Program 2 combines National Goals 2 and 3 due to the strong relationships between these goals and the small size of both programs in West Virginia. The small program size is partly due to loss of faculty who were replaced only recently. Research in the areas of human and animal nutrition, food quality and safety, and nutritional biochemistry has a prominent role in the strategic plan being developed by our College and we expect to make considerably greater contribution to these areas of research in our 2007-11 Plan of Work for USDA-CSREES. For example, faculty have this year initiated projects to evaluate the efficacy of dietary isoflavones and voluntary physical exercise in preventing

estrogen deficiency induced osteopenia and adiposity and to develop and assess intervention strategies to increase consumption of docosashexaenoic acid in the general population.

West Virginia is one of the most overweight of US states with both adults and youth impacted. Knowledge regarding relationships among familial factors, dietary patterns and body mass index of young children, will allow us to better address the serious and growing problem of childhood obesity in West Virginia. On-going research is providing information about these relationships in rural, Appalachian children that will allow us to design culturally sensitive, effective outreach and education programs.

The scope of Program 2 research efforts has included research in food quality and safety in support of state beef, poultry and aquaculture industries. Because fish proteins are especially susceptible to freeze and freeze-thaw cycle induced denaturation, one research focus has been on developing superior (measured by product quality and safety) methods of cryopreservation for fish fillet and restructured fish products. A recently instituted and related area or research involves developing improved methods for protein and lipid recovery from trout processing by-products. Finally, research is being instituted to evaluate and develop non-thermal electron beam treatment as a critical control point to minimize microbial contamination, particularly in ground meat products..

Assessment of Progress

Program 2 (National Goals 2 and 3) currently represents a very limited area of research in the West Virginia Station. Our expectation is that efforts in this area will increase considerably in the next 5-year Plan of Work. Given the limited personnel and operating support afforded these goals, progress has been acceptable.

Expenditures and SY for Program 2 (Goal 2 & 3)

Source	$ or SY
Formula	289,395
State Funding	202,056
SY's (FTE)	1.3

Key Theme 2.1 – Enhancing Safety and Quality of Food Products

a) Description: Research to increase food safety and product quality, focused on beef, poultry and aquaculture industries

b) Impacts:
Preharvest conditioning and stunning method are important variables to manage for enhancement of consumer acceptability of rainbow trout fillets. Development of stunning and handling protocols to minimize undue stress to the animal without compromising product attributes is critical. The objective of this study was to describe the effect of stunning method and feed withdrawal on postmortem metabolism and fillet attributes. Three stunning methods (ice slurry with CO2,

automated stunning, and manual stunning) and two feed withdrawal periods (none, one-week) generated 6 treatments that were replicated four times. For each treatment combination, 5 fish were used to determine fillet yield, cook yield, composition, texture, psychrotrophic bacterial counts and color; three fish were used to monitor muscle pH, temperature, and rigor index at 0, 0.5, 1, 2, 4, 8, and 24 h post harvest. Stunning method did not affect ($P>0.05$) fillet composition, color, or texture; however, rigor onset was more rapid in fish stunned using an ice slurry purged with CO2. One-week feed withdrawal increased ($P<0.05$) fillet yield (71.4 vs 69.6%), cook yield (84.9 vs 84.2%), Kramer shear force (490.9 vs 433.3 g/g) and, and it decreased psychrotrophic bacterial counts (11.1 vs 0.7 colony forming units/cm2). Fillet color and composition were not affected ($P>0.05$) by feed withdrawal. #

Based on the lab-scale system for recovery of lipid and protein by-product from fish processing, a pilot scale continuous system was designed and tested. We tested a homogenizer and two bio-reactors. We have also tested various separators from different manufacturers. The CEPA continuous centrifuge and CARR Centritech pilot system did not work in our system. We have also tested a centrifuge-decanter by Alfa Laval in conjunction with our homogenizer and bio-reactors. The decanter worked well. #

The D10-value is a proportionate reduction of a microbial population expressed as the e-beam dose required to inactivate 1-log (equivalent of 90%) of the initial microbial population. Fresh meat products such as ground beef, chicken, and fish fillets usually do not use a pasteurization step as a means to inactivate microorganisms such as Escherichia coli O157:H7 (E. coli) due to the heat involved. However, Electron beam (e-beam) exposure inactivates microorganisms in a non-thermal manner. Therefore, e-beam could be applied to fresh meat products to achieve high standards of microbial safety while maintaining the fresh symbol of identity of those products. The objective of this study was to determine D10-values for E. coli subjected to e-beam at three different temperatures in ground beef, chicken, and trout fillets. E. coli was inoculated into ground beef, boneless skinless chicken breast meat, and boneless skinless trout fillets. Sample temperature was equilibrated to -20, 4, and 22C. Samples were subjected to e-beam at 0 (control), 0.5, 1.0, 2.0, 2.5, and 3.0 kGy. Survivors were enumerated using standard spread-plating method. Survivor curves were plotted on a logarithmic scale as a function of e-beam dose for each meat sample at each different temperature. D10-values were calculated as an inverse reciprocal of the slope of the survivor curves. Results were analyzed by analysis of variance for a completely random design model. D10-values ranged from 0.22 to 0.35 kGy for E. coli in trout at 4C and chicken at -20C, respectively. Regardless of temperature, chicken had highest D10- value followed by beef and trout. D10-values of frozen samples were higher than D10-values of samples irradiated at 4 and 22C regardless of species. Although there were differences between D10-values for samples at 4 or -20C, they were statistically insignificant.

The objective of a second study was to determine D10-values for Escherichia coli O157:H7 (E. coli) subjected to e-beam at three different water activities (Aw) in fresh

meats. Aw of ground beef, boneless skinless chicken breast meat, and boneless skinless trout fillets was adjusted to 1.00 (control), 0.98, and 0.96 by partial vacuum drying. E. coli was inoculated in meat samples and temperature was adjusted to 4C. Samples were subjected to e-beam and survivors were enumerated. Survivor curves were plotted and D10-values were calculated. Results were analyzed by analysis of variance for a completely random design model. D10-values ranged from 0.22 to 0.35 kGy for E. coli in trout (Aw=1.00) and chicken (Aw=0.96), respectively. Regardless of Aw, chicken had highest D10-value followed by trout and beef. Although D10-values for trout and beef were numerically different, the difference was insignificant. D10-values for samples with Aw=1.00, 0.98, and 0.96 were 0.254, 0.317, and 0.319, respectively. D10-values for samples with Aw=1.00 were significantly lower than those with reduced Aw. Shouldering of survivor curve was observed in reduced Aw samples. E-beam effectively reduced E. coli O157:H7 in meat products even at reduced Aw. Water radio-lysis is considered as an indirect mechanism for microbial inactivation. While the physical state of water (frozen or un-frozen) in foods seems to be a major contributor to microbial inactivation by e-beam, water temperature most likely plays a minor role. Due to the significant effect of Aw on D10-values, e-beam treatment could be applied to products before Aw-reducing techniques are employed. However, this would require stringent control following irradiation. #

c) Source of Funding: Hatch, State

d) Scope of Impact: Integrated research and extension

Key Theme 2.2 – Promoting Healthy Nutrition for Rural Families

a) Description: Research to document and improve nutritional and dietary practices of rural families.

b) Impacts:
National surveys have indicated that the percentage of overweight children doubles between the ages of three and five years. Early childhood is an ideal time to prevent the development of obesity and foster the development of lifestyle patterns that promote optimal health. This project was funded as a seed grant to identify environmental and familial factors that are associated with body mass index (BMI) of preschool aged children in two counties in rural West Virginia. Preschool aged children were recruited from Head Start programs, preschools, churches and community groups. Recruitment and data collection were carried out by Extension personnel in the counties. Children were weighed on an electronic scale to the nearest half pound and were measured on a portable stadiometer to the nearest half inch. BMI was calculated using the Centers for Disease Control and Prevention BMI calculator and BMI percentiles were determined using published growth charts. Children with BMI equal to or greater than the 85th percentile but less than the 95th percentile were considered at risk for overweight and those with BMI equal to or greater than the 95th percentile were considered overweight.

Two-hundred one preschool children from two rural counties were enrolled in this project. They ranged in age from 25.5 months to 71.8 months. About 11 percent of the children were African American with the remainder Caucasian. Thirty-eight (19%) of the children were overweight and another 30 (15%) were at risk for overweight. Factors that will be analyzed for their associations with BMI will be mothers BMI, fathers BMI, mothers nutrition knowledge, food security, number of hours that parents work per week, parents education level, and the presence of a television in the child's bedroom. Data from this study will be used by the Extension Service to inform their on-going nutrition education activities. It will be used to design one or more culturally competent interventions that can be tested for their impact on weight and weight change. It will be used by local schools, community organizations, and policy makers to define the scope of the obesity problem among preschool aged children in this area of West Virginia. #

A project is underway to develop value added foods using protein and lipid recovered from trout processing by-products (approximate 40% of initial weight). Solubility of myofibrillar and sarcoplasmic proteins was highest at pH values of 2.5 and 12.5 with precipitation highest at pH 5.5 where recovery yields approached 90%. Proteins recovered were used to develop protein gels which exhibited superior gel strength. Food products reconstituted using protein and lipid recovered from trout processing byproducts showed omega-3 and omega-6 concentrations in recovered lipids generally three times higher than in trout muscle. Concentrations of linolenic, EPA, DHA, linoleic, and arachidonic acids ranged from three to five times higher than in trout muscle. Additionally, preliminary results show rainbow trout fed flax oil yield fillets with increased levels of omega-3 fatty acids. #

c) Funding Source: Hatch, State

d) Scope of Impact: State specific

Program 3 (National Goal 4) – Greater harmony between agriculture and forestry practices and the environment

Overview

Research to support preservation of West Virginia's soil, water, forest and wildlife resources is an increasingly high priority in the West Virginia Station. Key research themes include protecting soil and water quality and developing economically effective and environmentally sustainable management practices for agriculture, forestry and other points of interaction of man and environment. Contamination of soil and eventually ground water with acid mine drainage from abandoned mines, and from more recent surface mining, is a growing state concern. Research is being conducted to characterize the nature and scope of these problems and to develop effective and cost effective remediation programs.

Most acid mine drainage sites involve complex mixtures of contaminants. Efforts to define the nature and scope of the contamination have used both actual mine drainage sites and simulated drainage situations. Examples of the former include comparing wetlands impacted by the release of metal-laden sediments from acid mine drainage and those not so impacted. Research with simulated mine drainage is measuring, under laboratory conditions, impacts of sulfate, neutralizing cation action and endpoint pH on acid mine drainage neutralization with the goal of designing more efficient acid mine drainage treatment systems.

Research to develop environmentally sustainable practices for managing farms and forests is an important component of overall Station goals to position state producers to compete more effectively in organic or "green" markets and to preserve West Virginia lands, forests, wildlife, soil and water resources for future generations. Examples include the development of soft chemical and mating disruption programs to minimize insect damage to tree fruit orchards, efforts to document and correct as necessary, impacts on non-target species from efforts to control gypsy moth defoliation of state forest lands, and developing methods to objectively assess value of environmentally sustainable practices.

Assessment of Progress

Progress toward achieving the objectives of Program 3 (National Goal 4) is acceptable. Of particular note are results documenting impacts on wetlands from surface and acid mine drainage and improving remediation methods as well as the successful simulation of acid mine drainage remediation under laboratory conditions.

Expenditures and SY for Program 3 (Goal 4)

Source	$ or SY
Formula	782,274
State Funding	683,991
SY's (FTE)	7.4

Key Theme 3.1 – Protecting Soil and Water Quality

a) Description: Research to evaluate soil and water quality, develop methods to prevent soil and water contamination and, where necessary, develop effective and cost efficient remediation programs

b) Impacts:
A study conducted in the Cherry River watershed on the Monongahela National Forest in eastern West Virginia was to determine physical and chemical properties of the soils, to classify soils, and to assess the acid risk to the forests. Sixty-seven pedons were sampled by horizon across six landscape positions in an eastern and in a western area of the watershed. All soils in the watershed were acid and classified either as Inceptisols or Ultisols. The eastern area soils were more acid than the western area soils because of geological differences. Soils on shoulder positions had the highest risk and soils on floodplains had the lowest risk of forest productivity decline. While

both areas showed high acidification and forest productivity risk, the eastern area soils will have higher risk for forest productivity decline in the future. While a few forest regeneration failures are known to have occurred after harvesting in this area, further acidification potentially will reduce the regeneration of a marketable timber stand.

A second study included mapping soil phosphorus adsorption capacity (PAC) in West Virginia. Extensive pedon data for PAC have been collected for several years. However, we must be able to extrapolate the intensive field and laboratory data to broader landscapes to facilitate land use and management decisions. The objective of this study was to use previously collected data on West Virginia soils to develop county-wide and state-wide maps of PAC. Characterization data were collected on 85 pedons from 31 soil series (including 57 pedons from 17 benchmark soils) throughout the agriculturally important regions of WV. From these samples, PAC (mg P/kg soil) for each genetic horizon was determined by incubating 0.5 g soil for 18 hours with 30 mL of 0.01M CaCl2 solution containing a series of P concentrations. PAC (mg P/m2 soil) of each horizon was calculated using PAC of each sample, bulk density (BD), horizon thickness (T), and a rock fragment correction factor (RFCF = 1 - percent rock fragments), as well as a unit conversion factor (UCF): PAC (kg P/m2) = PAC (mg P/kg soil) x BD x T x RFCF x UCF. PAC for a given pedon was determined for the upper 20 cm by adding the PAC values for all or part of any horizon within the upper 20 cm of the soil. We used available Soil Survey Geographic (SSURGO) data to generate county-wide and state-wide maps of estimated PAC by assigning the PAC value of the dominant soil map unit component series to each map unit. The next step for this project will be to use land use information for each sampled pedon to map PAC using SSURGO data as conditioned by land use. To increase the areal extent of the mapping we intend to link measured PAC data to SSURGO map units at higher taxonomic levels (e.g., family or subgroup). Also, we will examine spatial trends in mapped PAC data. #

Two areas of the Cherry River watershed show distinctly different stream chemistry; the west side of the watershed has streams with an average pH of 5.8 and acid neutralizing capacity (ANC) of 4.0 microequivalents/L, while the east side streams have an average pH of 4.7 and ANC of -16.1 microequivalents/L. The objectives of this study were to determine the chemical properties of the soils in these two areas and to assess the acid risk to the forests on each area. Sixty-seven soil pedons (36 in the east, 31 in the west) were sampled by horizon across six landscape positions (ridge, shoulder, back slope, bench, foot slope, floodplain) and the soil samples collected from each horizon were analyzed for soil acidification properties. Two major properties of the soils were used for acid risk assessment: Ca:Al molar ratios and base saturation of the effective cation exchange capacity. The soils of the Cherry River watershed all showed signs of soil acidification. The east area soils were more acid than the west area soils. All residual soils (soils formed in place) had lower base cation concentrations than the colluvial (soils derived from erosion and materials up slope)and alluvial (soils derived from sediments deposited by water) soils. The soils on the shoulders (residual) showed the highest risk of forest productivity decline. The

floodplain (alluvial) soils showed the lowest risk of forest productivity decline and the highest base cation concentrations. While both areas showed high acidification and forest productivity risk, the east area soils have a slightly higher risk for forest productivity decline in the future.#

Three hydropedology-related projects were initiated. The first ("Hydrologic and Morphologic Characterization of Seasonally-Saturated Soils for Improved Land Use Evaluation") is a traditional water table monitoring study in cooperation with the USDA Natural Resource Conservation Service (NRCS) and the USDA Forest Service, looking at multiple soils of local importance in West Virginia where soil morphology and observed or inferred hydrology do not agree, thus presenting problems for classification or interpretation. We have constructed and begun to install specially-designed monitoring wells (maximum water table recording devices, or MWTRD). Specific sites include: (i) soils with perched water tables above fragipans, (ii) high-elevation soils in the frigid soil temperature regime, (iii) soils with perched water tables above slowly permeable clay layers, and (iv) soils with perched water tables above shallow bedrock. The second ("Phosphorus Sorption Capacity of West Virginia Soils: Spatial Assessment and in situ Leachability") will investigate the occurrence (or lack thereof) of deep leaching and preferential flow of phosphorus into and through the subsoil of benchmark West Virginia soils. A field study will be conducted in cooperation with the NRCS to assess the role of natural structure and preferential flow on the movement of phosphorus through undisturbed soil profiles. The third ("Seasonal Infiltration and Subsurface Water Dynamics across Benchmark Soil Catenas of Eastern West Virginia") will involve studies of infiltration and saturated hydraulic conductivity on benchmark soils that represent regional soil conditions and land use practices. This watershed-scale study in cooperation with the NRCS will assess soil hydrology across major landforms within a single watershed. Water infiltration will be measured on a variety of landforms under multiple land uses. Subsurface soil horizons thought to be aquitards or aquifers will be identified and will be exposed in surface pits. saturated hydraulic conductivity data will be collected by compact constant head permeameters in soil core holes and by constant head infiltrometers placed directly on exposed horizontal surfaces of subsurface horizons.#

This project was initiated to collect metal data for West Virginia soils. (1) Revegetation plots on surface coal mines were treated with fly ash and sewage sludge. Although metal differences were found among treatments five years after treatment, no differences were observed in metal availability among treatments after ten years. (2) A proposed section of Appalachian Corridor H will pass through wetlands and partially-reclaimed mined lands in a sensitive area. Spoils from past mining activities are generating acid mine drainage (AMD) and releasing metal-laden water and sediments into contiguous wetlands and streams. We evaluated soils on the mined lands, in wetlands, and surrounding upland landscapes. All soils were acid or extremely acid. Surface and deep core sampling documented that minesoil disturbance would potentially expose pyritic materials to accelerated weathering and increased AMD production. We recommended that the highway be relocated to

minimally disturb the mined areas. (3) AMD-impacted wetlands contiguous to the minesoils contained higher levels of total S than the non-impacted wetlands, and the S was more likely to be in the form of acid volatile sulfides, and/or chromium reducible sulfides. In the non-impacted wetlands, over 90% of the S was in the organic form. Total Fe was higher in the AMD-impacted than in the non-impacted wetlands, while total C and N and CEC were lower. Redox potential of the wetlands receiving AMD indicated the potential for Fe and sulfate reduction. (4) In MLRA-127, lead was higher in the surface than in the soils' subsurface horizons, indicating deposition. These soils had low concentrations of Ca and Mg. Organic horizons had higher concentrations than mineral horizons. Not only are these soils highly leached, but they also have acid parent materials. Higher levels of arsenic were found in the subsurface horizons of orchard soils than in other soils, relating to past pesticide spraying programs. The Toxicity Characteristic Leaching Procedure, a procedure recommended by the USEPA to measure hazardous waste or pollution potential of soils, was used to evaluate these soils. None of the soils had a pollution potential, since metal concentrations were below the procedure's detection limits. (5) Data from HF analyses of soils in MLRA-126 documented that most elements did not exceed the cumulative loading rate concentrations allowed by USEPA 503 regulations. Although there were some differences among soils, metals were found in ranges expected for non-polluted soils. However, Cd concentrations exceeded recommended values for waste application. (6) Some forest ecosystems may be subject to productivity decline due to losses of soil Ca and Mg. High elevation forests of West Virginia occur on frigid soils developed from acid sedimentary rocks. Total and exchangeable Ca and Mg values of MLRA-127 are very low relative to other eastern U.S. areas. Strong positive correlations existed between organic C and total Ca. Negative relationships existed between soil depth and total Ca and exchangeable Ca and Mg. Ca:Al ratios were so low that soils have a high risk for future regeneration of marketable timber. #

Organic solvents can influence the fate and transport of organic chemicals in the environment. This work has shown that solvents also play a role in the fate and transport of metals. Calcium-sodium exchange reactions on Wyoming bentonite in methanol, ethanol and acetone-water mixtures were investigated at room temperature. The expected increase in preference for calcium was only apparent after correction for the calcium-chloride monovalent pair. The effects of ethanol- and methanol-water mixtures on zinc and cadmium sorption onto bentonite and illite were determined. Bentonites are often part of the barrier systems that contain landfilled wastes while ethanol is a common gasoline oxygenate. Zinc sorption to bentonite decreased as ethanol concentration increased, suggesting a potential environmental threat resulting from increased transport of this metal when ethanol is present. #

The West Virginia Division of Highways is required to develop seeding mixtures comprised of native plants for revegetation of newly constructed highway corridors. The challenges faced when revegetating highway corridors are similar to those of reclaiming minelands. Similar processes such as blasting and backfilling result in a compacted, rocky soil that often contains acidic materials. Non-native species are

generally seeded with high fertilizer rates to assure revegetation success. However, these aggressive species prohibit the establishment of desirable native species. When using native species, soil properties are an important aspect of the revegetation process of these disturbed areas. The chemical properties of soils can be manipulated, however the physical properties are more difficult to influence without great expense. We evaluated the use of native plants for revegetation along roadsides and the soil factors influencing this reclamation. Soil properties of six West Virginia sites (Baker, Hazleton, Parkersburg, Buckhannon, Elkins, and Weston) were evaluated on the basis of bulk density, pH, electrical conductivity, texture, water holdingcapacity, cation exchange capacity, extractable bases, and various elemental analyses. Younger soils had less profile development as well as higher bulk densities, increased rock fragments, and decreased water holding capacities than older sites. Older sites with more vegetation had higher amounts of organic carbon in the soil, which translated into improved soil conditions and water holding capacity. Soil pH did not significantly influence native species establishment on these sites. The Elkins site had slightly saline soils as determined by electrical conductivity, which related to a decreased amount of vegetation on this site. Sites with higher amounts of vegetation correlated to soils with lower bulk densities, higher CEC and water holding capacities, and ample nutrients. #

Wetlands are extremely important environments that provide numerous ecosystem functions and values. However, wetlands continue to be destroyed for development. Efforts to construct and restore compensatory wetlands as mitigation for natural wetlands destroyed through highway development, timbering, mining, and other human activities in West Virginia is commonplace. However, better data are needed to evaluate these wetlands and to determine how they function compared to natural wetlands. Response to this effort is two-fold: 1)Monitoring procedures for wetland wildlife, macro-invertebrates, vegetation, and soils have been developed, and 2) A statewide sample of wetlands is being evaluated to determine the characteristics of natural and created sites that lead to good functional wetland scores. Results can be used to increase the success of restored and created wetlands. #

Experiments were initiated to study the survival and recovery of the opportunistic pathogen Enterobacter sakazakii from environmental sources. In order to investigate thermo-tolerance, the bacterium was subjected to several temperatures (46 to 52 degrees C) for extended periods of time. E. sakazakii was able to withstand 48 degrees C for several minutes, suggesting that preliminary exposure of environmental samples to this temperature may promote reduction of competing microorganisms, thereby enhancing recovery of E. sakazakii. Experiments conducted to evaluate the ability of E. sakazakii to survive in nutrient-deplete ground water at 25 degrees C indicated relatively minimal die-away following eleven days of stress (approximately one log reduction in survivors). In a second project, the effectiveness of two home aerobic waste treatment systems and a subsurface flow constructed wetland was examined for the treatment of domestic wastes produced in individual homes located in rural areas. Despite substantial reduction in five-day biological oxygen demand, effluent from one of the aerobic units failed to meet the required 20 mg/l limit. Also,

fecal coliform densities in effluents from both aerobic units exceeded the 200 colonies/100ml standard. In a related study, the effect of manure on soil microbial communities and soil quality for an upland pasture receiving low input management was examined. Parameters measured included soil microbial biomass, hot water extractable carbon, potentially mineralizable carbon, and soil carbon dioxide efflux. Microbial diversity was measured using community level physiological profiling and molecular characterization of the 16S ribosomal RNA genes by polymerase chain reaction and denaturing gradient gel electrophoresis. Culture-independent and culture-dependent methods for molecular characterization of genetic diversity were compared. Soil population grouping (according to soil fertility and manure application) varied with sample date and the methodology employed. #

c) Funding: Hatch, McIntire-Stennis and State

d) Scope of Impact: Multi-state, integrated research and extension
CT-NH, NA, ME, NH, NJ, NY-G, OA, VT

Key Theme 3.2 – Sustainable Agricultural and Forestry Practices

a) Description: Research to devise, evaluate, and implement alternative, sustainable agricultural and forestry practices.

b) Impacts:
Litter transport is a commonly utilized strategy to address nutrient excesses. However, little hard information is currently available on the transport and fate of litter other than the tonnages involved in state subsidy programs. During the past year, this project examined: (1) the willingness-to-pay (WTP) for litter from non-users of litter; and (2) documented the movement of litter. This research relied on data collected from a mail survey sent to 999 farmers in Hardy and Pendleton counties in West Virginia with response rate of 58%. The majority of non-poultry farmers (66%) have used litter recently. Litter is commonly either given away or traded for services rather than exchanged for cash. Farmers who responded that they would pay nothing for poultry litter cited mainly environmental rather than financial concerns about litter use. In cash markets, mean WTP for broiler litter among non-users ranged from $6.7 per ton in Pendleton to $4.3 per ton in Hardy. Pendleton was found to have a more active, cash compensation litter market. In addition, willingness to pay (WTP) for broiler litter among non-users in Pendleton County who were very certain about their WTP was found to be higher than current market prices for litter. The greater WTP in Pendleton County reflects both lower litter prices in this county due to an abundance of turkey litter as well as an opportunity for future growth in broiler litter use. Conversely, WTP in Hardy County was lower than current market price, reflecting a low potential for growth in litter use. 63% of poultry growers reported transferring some or all their litter off-farm. Not surprisingly, most litter (90%) stayed within the county where it was generated. Insufficient agricultural land resources are one reason why many growers transfer litter. Among broiler chicken growers, over half of the respondents did not have a land base sufficient to land apply

all their litter. A minority (15%) applied all their litter on-farm even though the farmer owned or rented insufficient acreage for litter application. #

In urban developments, turf is often established under sub-optimal soil conditions opportune for weed infestations. Experiments were completed in 2004 to evaluate the incorporation of composted poultry litter on turfgrass establishment, soil properties, and weed pressure. To simulate construction disturbance, 20 cm of topsoil was removed. Composted poultry litter, a waste product derived from the poultry industry, was incorporated to a depth of 12.5 cm at 10, 20, and 40% vol/vol (4.4, 8.8, and 17.5x104 Kg ha-1, respectively) prior to seeding or sodding Kentucky bluegrass (Poa pratensis). Composted plots were compared to fertilized plots (20-27-5, N-P2O5-K2O, to provide 146 kg/ha of Nitrogen), or control plots. Composted poultry litter elevated the soil organic matter and its water holding capacity. It also raised the soil pH along with levels of extractable K, Ca, and Mg. Besides, composted poultry litter increased CEC by 15-68%, and decreased the bulk density up to 42%. In spring 2004, 85% turfgrass cover was recorded in plots with 20% compost. One year after seeding, all compost-treated plots exhibited 100% turf cover. Only one-third and two-third of the control plots were covered by turf during spring and fall of 2004, respectively. Weeds monitored included common dandelion (Taraxacum officinale), buckhorn plantain (Plantago lanceolata), yellow woodsorrel (Oxalis stricta), and white clover (Trifolium repens). Plots with 20 and 40% compost had six percent and 72% fewer total weeds, respectively, than control. Fertilized plots exhibited weed pressure similar to control. Overall, compost treatments were able to maintain superior turf cover and quality and lower weed populations compared to conventionally fertilized or control plots. #

The role in forest nutrition of woody residues remaining after forest harvest is not well understood. After harvest woody residues can be extensively removed as in plantation forests, or retained on the ground in substantial amounts as in some hardwood forests. As a large carbon pool, woody residues may sequester site resources and act as sink, especially for nitrogen, or be a source of nutrients. Empirical evidence of either path is lacking, but as an N sink, woody residues could help retain N on site-for-site productivity enhancement in N-limited forests, or for water quality protection in N-saturated forests. While empirical evidence for woody residues acting as sink or source of some nutrients is difficult to obtain due to long time periods involved in wood decomposition, modeling of these processes will help us better understand the implications of these two divergent roles of woody residues for site productivity and water quality protection.

Project work in 2005 focused on modeling of carbon stocks and nitrogen dynamics in woody residues remaining on sites after harvesting. This work elucidates the effects of forest management on carbon and nutrient pools and cycling, and on long-term site productivity. The project supported a technician to conduct a literature search on available models. Additionally, a pilot project was started at the West Virginia University Research Forest to determine empirically how nitrogen cycles in a forest floor decomposition matrix, particularly from decomposing hardwood leaves in

contact with small woody pieces as a carbon source. Initial samples have been collected and will be processed for nutrient analysis. #

Since 2000 we have completed the field and lab work, analyses, and final report for the study of long term evaluation of Bacillus thuringiensis kurstaki, Gypchek, and Entomophaga maimaiga fungus on nontarget organisms in hardwood forests in the central Appalachians. The most severely impacted organisms are spring-feeding caterpillars and predators and parasitoids most dependent on them. Generalists predators are not affected. Recovery from impact occurs by the second or third year post treatment.We have made recommendations to minimize Btk impact on nontargets, and have suggested monitoring methods and indicator species to use for future evaluations. #

Bird populations and vegetation structure have been monitored between 1984-1998 at the Sleepy Creek Public Hunting and Fishing Area, located in the Eastern Panhandle of West Virginia. During a gypsy moth outbreak during 1987-88, population control methods were not attempted, which resulted in outbreak populations accompanied by severe efoliation and concomitant tree mortality. Ground foraging bird species, including the Eastern Towhee, showed a dramatic increase in population. Despite a nearly 40% reduction in large overstory trees, there were no general declines in bird species usually associated with that habitat type, including two species thought to be at risk in the east, Cerulean Warblers (Dendroica cerulea) and Scarlet Tanagers (Piranga olivacea). This indicates that possible refugia exist for these birds at Sleepy Creek. Examination of landscape features using GIS software may provide answers to this perceived anomaly. Input data include the GPS locations of each permanent study plot, vegetation structure and bird population estimates for those plots. #

The objective of this research is to determine habitat components governing brook trout population dynamics in the central Appalachians at both large spatial and temporal scales. Twenty-five streams were selected and included in the 10-year study on brook trout population dynamics in WV headwater streams. All streams contain naturally reproducing brook trout, and represent five different geologic types. Most streams are located within the Monongahela National Forest, while a few (8) are found in the MeadWestvaco Ecosystem Research Forest and nearby lands. Fish collections have taken place on all streams during fall to assess both adult use and young-of-year recruitment from the previous year. Collections were made using electrofishing and removal sampling. Fish samples were completed in fall 2003, 2004, and 2005. Habitat measures were collected during summer base flow conditions. During 2003, eight streams were sampled for habitat and during 2004 the remaining 17 streams were completed. In 2005, we began the second round of habitat sampling with 12 streams measured. The remaining 13 streams will be reassessed for habitat in summer 2006. Spawning substrate samples were collected from all study streams each fall during fish surveys. All samples from 2003 and 2004 have been dried and processed through a series of Wentworth sieves to evaluate the levels of fine sediments in each stream. These data presently are being related to subsequent recruitment of young-of-year brook trout from 2003 (assessed in 2004) and 2004

(assessed in 2005). Fall 2005 sediment samples are currently being dried and processed. Short-term studies have also been conducted as part of this project. In 2005, a study was completed that examined diets and feeding success of brook trout at different positions within the Middle Fork River watershed. Brook trout were not found to distribute based upon food resource availability and upper sites (headwater streams) generally had higher trout densities and lower food consumption rates than sites lower in the watershed. Further, terrestrial invertebrates were found to be critical to sustaining brook trout production. These data suggest that terrestrial land use and management of forests may play a key role in determining brook trout production in these streams. #

Phenological effects of triclopyr ester. Objectives: 1) define optimal treatment windows (herbicide timing) for the effective control of Ailanthus altissima using Garlon 4, 2)reduce the amount of herbicide; minimize time and labor costs associated with chemical control of tree-of-heaven, 3)host a workshop on tree-of-heaven control methods (2005). One hundred and twenty-two trees were randomly assigned a date for treatment, or designated as a control tree. Height and DBH of the controls were measured every week throughout the growing season. Four trees per week were treated using low-volume basal bark treatments with 20 percent Garlon 4 in Aqumix oil. Brush and tree trunks were sprayed to thoroughly wet the lower stems, including the root collar area, but not to the point of runoff (Kochenderfer et al. 2001). In August 2004, we applied Accord (glyphosate) on cut stumps, Accord hack-and-squirt, Garlon 4 cut stump treatment, Garlon 4 hack and squirt, Arsenal (imazypyr) applied with EZJect Lance, Garlon 3A (amine form of triclopyr) with EZJect Lance, and Accord with EZJect Lance. An educational tour of the study site took place in October 2005. Six people attended. The study was described and the results discussed with the tour participants.

Injection versus basal bark treatment of Ailanthus altissima. Objectives: 1) test the efficacy of different control measure for ailanthus altissma including two application methods (herbicide injection lance and low volume basal bark band) using two different herbicide formulas (Garlon 4 triclopyr and Stalker imazayr), 2) look at the possibility of damage to non-target stems through root connections when using imazapyr. In summer 2004, we selected and treated 150 Ailanthus trees along a one half mile site along Interstate 79. Treatments included: 1) Garlon 4 in Aqumix, 2) Stalker in Aqumix, 3) Imazapyr capsule injection with EZject, 4)Triclopyr capsule injection with EZject Year two measurements were made and a research paper (Testing the Efficacy of Triclopyr and Imazapyr Using Two Application Methods for Controlling Tree-of-heaven along a West Virginia Highway) was accepted for the Central Hardwoods Forest Conference. Study 3. Triclopyr x imazapyr basal bark treatments of Ailanthus altissima. Objectives: 1) determine the efficacy of different herbicide combinations in controlling the exotic invasive Ailanthus altissma, 2) look at the possibility of damage to non-target stems through root connections when using imazapyr. One hundred and five Ailanthus stems were selected in a road cut along the southbound lane of I-79, north of Exit 139 East Fairmont. Each of six treatments was randomly applied to 15 stems. An additional 15 stems serve as untreated controls.

c) Funding: Hatch, McIntire-Stennis and State

d) Scope of Impact: Multi-state, integrated research and extension
CT-NH, MA, ME, NH, NJ, NY-G, NY-I, PA, VT

Program 4 (National Goal 5): Enhance economic opportunity and quality of life for rural citizens and communities.

Overview

Stagnant or declining per capita income, population outflow and unemployment are chronic problems in some areas of West Virginia. Research to develop technologies and management systems which promote economic development consequently represents a high priority in the West Virginia Station. Additionally, research which supports improvements in factors independent of income which affect quality of life may be equally important in stemming outflows of human capital.

The predominantly rural character of West Virginia dictates that Station research will focus on economic development and quality of life issues primarily in rural communities having agricultural and/or forest based economies.

Assessment of Progress

Progress toward achieving objectives of Program 4 (National Goal 5) were modest but acceptable given the limited resources allocated to this program. Results documenting a potential to substantially increase producer income with integrated systems of birth to market beef production are encouraging as is the ability to utilize treated mine drainage in aquaculture production. Working with numerous community-based projects to develop forest heritage tourism and direct marketing opportunities for farmers have been extremely successful to date and results showing small business to collectively have a substantial impact on economic development is encouraging. Obtaining premium prices for hardwood products produced by sustainable methods also may offer potential for small, niche markets

Expenditures and SY for Program 4 (Goal 5)

Source	$ or SY
Formula	565,215
State Funding	549,226
SY's (FTE)	7.7

Key Theme 4.1 – Enhancing Community Economic Development

a) Description: Research to assist rural communities in developing profitable and sustainable local industries.

b) Impacts:

A continuous system which allows recovery of protein and lipids from fish processing by-products has been developed. Based on lab results from batch processing, a pilot process using continuous feeding of substrate increased greatly efficiency of the process. Protein recovery was approximately 90% on a dry weight basis and is based on isoelectric solubilization and precipitation of trout muscle protein. We expect to develop protein and lipid recovery technology to a semi-industrial level of application which will allow recovery in quantities sufficient for development of marketable value-added food products. #

Initial analysis of the Tucker County land use project data showed the price of properties was related to characteristics of the parcel including proximity to major roads, ski resorts, and view using a hedonic model. Efforts are underway to incorporate spatial statistical properties into the model. A draft framework for analyzing the effects of different levels of development in the county was prepared and circulated for peer review. For the historical resource management project data were gathered on the location and characteristics of historic properties in West Virginia and on the socio-economic characteristics of the counties in which the properties are located.

Results will facilitate decisions regarding easements by enabling more proactive approaches and by allowing budget constraints to be integrated into the decision making process to help ensure easements are sustainable. In two years of use of this information, the Land Trust has been able to increase the number of easements on private property by 26% to over 18,000 hectares. In other studies where parcel data becomes available this approach can help other agencies and managers develop long term sustainable implementation plans for extending regional conservation planning to the parcel level and to explore policy and management considerations and budgetary needs to meet their defined goals.

Related work provides a framework for local planners and public interest groups to analyze the benefits and costs of adding and maintaining street trees to local neighborhoods. Methodologies were developed to allow land-use planners to assess the impacts of highway projects on projected development and on land prices. #

There has been no comprehensive description of West Virginia's non-industrial private forest (NIPF) landowners in almost 30 years. Moreover, on-going landowner surveys do not collect information on key economic variables such as knowledge of forestry and markets, level of capital constraints, knowledge and utilization of existing tax laws, quantity of timber and non-timber outputs, and level of investment in forest management activities. An updated and comprehensive survey of NIPF landowners in the State will provide a better understanding of West Virginia's private timberland resource base. Such information will be useful in evaluating implications of NIPF landowners' forest management decisions and activities in the production and utilization of hardwood resources in the State. The 2005 West Virginia Forest Landowner Survey and cover letters were developed in the spring of 2005 and

approved by the Institutional Review Board (IRB) in the summer of 2005. The survey was carried out in the fall of 2005. Data analysis will follow. #

The traditions, mores, philosophies, and daily activities of an era are often reflected in the design, arrangement, and character of the built environments. This study is designed to capture this ethos of WV coal camps, 1900-1930. The intent is to chronicle the history and personality of built environments in coal mining towns in southern West Virginia through descriptive drawings. Once this visual profile is developed it can serve as a marketing tool to further educate the public about our heritage or a reference document for preservation and restoration.

A major goal of this endeavor is to reveal the character and quality of life in coal camps through drawings of the built environments in a way that it would encourage tourism which would benefit our rural economies. This project would also produce a visual record of a dying style of life in our state. Prototypical communities along the Coal Heritage Trail in southern West Virginia were visited. Of those visited the communities with the most promise for opportunities to photograph, draw, and gain access to the interiors of coal camp structures were Glen White and Winding Gulf. Bramwell which is a town made up from the coal property owners was also visited. Although the prospect of gaining access to those properties was not as strong as the other two communities. The structures are being restored and many are in excellent condition for recording the lifestyle of the people who lived in the communities by recording the structures. An initial search was made at the West Virginia University library for pictures and records of the structures are being restored and many are in excellent condition for recording the lifestyle of the people who lived in the communities by recording the structures. An initial search was made at the West Virginia University library for pictures and records of the structures in the coal camps of southern West Virginia. Gatekeepers were identified and contacted for the communities along the Coal Heritage Trail. No Gatekeepers were identified for access to interior spaces in Bramwell but, that search is continuing. Data collection in the form of photographs of existing structures in the Glen White and Winding Gulf areas has been done. Library photographs have been copied and exterior shots of the community of Bramwell have been developed and organized. Some sketches have been done from the library photographs.

A principle objective of this project was to examine the economic feasibility, risk characteristics, and market potential of niche or specialty products such as trout and other cool-water aquaculture species, pasture-based beef, and organic agriculture. Such products have the potential to enhance farm profitability, while contributing to environmental quality and economic development in WV and surrounding parts of Appalachia. Thus, as part of our analysis, we constructed enterprise (or cost and return) budgets, estimated optimization and related economic models, and conducted mail surveys and associated statistical analyses. Overall, we found that while all of the niche products examined were profitable under the conditions investigated, some (such as organic products and aquaculture) are accompanied by higher levels of economic or market risk than others (such as pasture-based beef). With respect to

pasture-based beef, for example, we found it to be consistently associated with higher potential profits and less risk of economic loss, even in seasons of poor animal and pasture performance. Such results need to be reinforced by additional studies. As with any growing sector, the economic development impacts of niche products can be substantial. With respect to aquaculture, for example, we find that, by virtue of its linkages with other sectors of the economy, a 50% increase in production volume (estimated currently at around $2 million per year) could increase total output in the state by $2 million annually, generate an additional $1 million in income and business taxes, and add 55 jobs. Alternatively, if the number of anglers or angler visits increased by 10%, an estimated increase of $2.5 million in annual statewide production activity, $1.5 million increase in income, and the creation of 59 additional jobs could occur. In terms of pasture-raised beef, the impacts could be even more substantial given that cow-calf production is already pervasive in WV, amounting to a $250 million sector, utilizing a million-acre pasture resource. As a relatively new product, the demand for pasture-based beef is growing in part due to the perception of its being healthier, locally-produced, and environmentally friendly. If all the beef currently used in school lunch programs across WV were replaced by pasture-raised beef, for example, this would necessitate the production of an additional 40 million pounds of beef (or 60,000 animals), resulting in an estimated $115 million increase in total statewide output and 1,700 additional jobs in various sectors. While such results are intended to be illustrative, they underscore the potential importance of niche products to the state economy. A summary of how agriculture in general or the above niche products in particular contribute to statewide economic development is available at: http://www.caf.wvu.edu/gdsouzawww/agricultureinWVeconomy.pdf. #

Relationships between small business development, economic growth, and poverty alleviation in West Virginia were analyzed using time-series data from 1980 to 2001. Four econometric equations in double-log form were regressed using OLS and 2SLS. The results of these regressions show that: (1) there is a robust, positive relationship between the relative size of small business and economic growth, even when controlling both for other growth determinant variables and for simultaneity bias; (2) there is a strong inverse relationship between the relative size of small business and the incidence of poverty; (3) there is a strong inverse relationship between the per capita Real Gross State Product growth and the incidence of poverty; (4) the autonomous impact of the relative size of small business on poverty rate is mild and insignificant, indicating that the strong inverse relation given in (2) is through economic growth rather than a direct one. Thus, the anti-poverty impact of small business development is mainly through its impact on economic growth of the economy as given in (1). The empirical result establishes the link between small business development, economic growth, and poverty alleviation. The study supports the anti-poverty impacts of small business development research findings in the literature. Moreover, the empirical results and analysis show that unemployment rate has a strong counter-cyclical impact on economic growth and cyclical effect on the incidence of poverty. However, Government Transfer programs are positively related with the incidence of poverty, possibly because they act as disincentives to work, or they may not be high enough to put the recipients above the poverty line. This

indicates that strong macroeconomic performance is a key factor for poverty alleviation. #

c) Source of Funding: Hatch, State

d) Scope of Impact: Multi-state research
CT-NH, MD, NJ, NY-C, PA, VA

Key Theme 4.2 – Improving Quality of Life for State Citizens

a) Description: Research to enhance quality of life for state citizens

b) Impacts:
Outdoor recreation can afford restorative experiences such as opportunities to reduce stress and facilitate recovery from illness. As health benefits associated with recreation become increasingly more important in our society, it will be helpful to understand whether and how trail design and resource impacts of recreational areas influence the quantity and quality of restorative character managers provide. The focus of research has been on understanding the quality-side (what happens). What is missing from the literature is a better understanding of predictors of quantity experiences (how much happens). Gibson's environmental perception theory was used to conceptualize quantity and quality experiences. Through an extensive research program, Gibson suggests that situations or events involving the coupling of actors and environments are meaningful. Events were used as a unit of analysis to measure the overall quality and quantity of the restorative character of an experience. Quantity was measured on an eventfulness scale ranging from 'not much happened' to 'a lot happened.' Continuous Audience Response Technology was used to evaluate video simulating hiking events on trails in the Monongahela National Forest. Eight wilderness trail segments were selected. While walking along each segment, 90 seconds of visual media was filmed as stimuli.

As study participants (N=42) watched the video, they rated the restorative character by turning a handheld dial with a scale ranging from 0 (low) to 100 (high). Data were automatically recorded at one second intervals. Following each video, respondents evaluated Kaplans' four components of restorative environments (being away, extent, fascination, and compatibility), overall quality, and eventfulness. The number of dial turns was correlated with eventfulness ($r=0.214$, $p<.001$) but not quality. Average restorative character across the video was more strongly related to quality ($r=.649$, $p<.001$) when compared to quantity ($r=0.296$, $p<.001$).

Two models predicting quality ($R2=0.547$, $p<.001$) and quantity ($R2=0.165$, $p<.001$) restorative character were developed using stepwise regression. Independent variables include the four factors of restorative character, average restorative character across the video, and number of changes (positive and negative dial turns) in character. Average character and fascination (absorption in the surroundings) were more strongly related to overall quality when compared to quantity. The number of positive changes in character and extent (differences perceived in the environment) were more

strongly related to quantity. These findings suggest that quality and quantity are different constructs of restorative character. Quality seems to be related more to a cognitive process associated with fascination. Quantity seems to be more objective and more closely related to extent, a process associated with direct perception. Respondents were more likely to react to positive changes in character. Providing more variety in scenery (e.g., vistas) and minimizing resource impacts can contribute to more eventful and high quality restorative opportunities, a more productive wilderness experience. #

Interpretation is an important tool when utilized appropriately by practitioners, from land management agencies to non-profit organizations to private businesses. Interpretation is used by natural resource agencies to achieve a variety of benefits, including: resource protection, enhanced public safety, increased public support, and increased enjoyment of the site for visitors. However, until the last few decades interpretation has suffered from the lack of a theoretically derived foundation. This study will build on recent theory-driven research to continue to address the needs of interpretive practitioners. It will focus on a number of interpretive objectives, including interpretive program and product development and evaluation, as well as measuring the effectiveness of interpretation and education programs, products, and tools.

A multi-phase research approach is being implemented, and will look at the following topics: 1) evaluating interpretive certification program effectiveness, 2) assessing linkages between interpretation and tourism (value-added components), and 3) the impacts and effectiveness of changing technology on interpretation. This project has currently begun the evaluation phase of interpretive certification programs. In recent years, two of the main players in the field of interpretation, the National Park Service (NPS) and the National Association for Interpretation (NAI), have come up with different certification programs, yet little has been done to evaluate such standards.

The effectiveness of such certification processes needs to be studied in order to see if they are meeting their objectives. A literature review is underway addressing how interpretive programs, products, and employees have been conducted in the past. Initial contacts have been made with the National Park Service, and the next step will involve a pilot study of their Interpretive Development Program. Research questions to be addressed include: 1) Are interpretive certification processes meeting their goals and objectives?, 2) Does the public (the visitors) benefit from these certification practices? Are certified interpreters more effective than non-certified interpreters?, 3) Are certification standards adding measurable value to interpretive products? Are interpreters who participate in the NPS certification process benefiting from the process (i.e., becoming better interpreters, developing professionally, etc.)?, and 4) What is the most efficient method for the NPS to evaluate interpretive products? #

Data analyses were completed and revealed that significant relationships existed between Adolescent body satisfaction and levels of extracurricular activity, sports participation, and media exposure. There also were sex differences in body

satisfaction and its predictors. Girls generally indicated lower body satisfaction and were more prone to the influences of parents, peers, and the media in determining their levels of body satisfaction. Positive adolescent perceptions the parent-adolescent relationship was a protective factor in encouraging body satisfaction and preventing overweight preoccupation and risky body-management behaviors, particularly among girls. Demographic factors like parental education level, household composition, and racial/ethnic heritage were not significantly related to body satisfaction among this sample of West Virginia Adolescents. Body image was found to have significant correlations to many dimensions of self-esteem, including self-liking, feelings of self-competence, academic self-esteem, and social self-esteem in the West Virginia sample. Body dissatisfaction and overweight preoccupation were also significantly related to feelings of loneliness. Remarkably, 39% of participants reported self-perceptions that they were at least a little overweight while their body mass indices indicated that 9% were slightly overweight and 8% were obese. It is possible that 22% of the sample misperceived themselves as overweight. This finding has important implications because self classified weight had a strong negative relationship ($r = -.377$, $p < 0.01$) with body satisfaction. Meanwhile, Body Satisfaction had a negative relationship with overweight preoccupation ($r = -.358$, $p < 0.01$) and with risky body management behaviors ($r = -.201$, $p < 0.01$). Moreover, academic self-esteem, general self-esteem and positive perceptions of the parent-adolescent relationship were all negatively correlated with risky body management behaviors, with correlations ranging from ($r = -.206$, $p < 0.01$) to ($r = -.253$, $p < 0.01$). The health and fitness orientations and health and fitness self-evaluations of West Virginia Adolescents was also investigated in relationship to demographics,weight, leisure activities, and self-esteem. Parents education levels were positively related to health and fitness orientations($r=.227$, $p < 0.01$)and health and fitness evaluations($r = .215$, p , 0.01). Predictably, team sport and individual sports participation were positively related to health and fitness orientations and evaluations, as was sports media consumption. Having an older sister was negatively related to health and fitness evaluations ($r = -.158$, $p < 0.01$). Both health and fitness orientations and evaluations had strong positive relationships to self-esteem and were of equal value ($r = .513$, $p < 0.01$). #

This research was undertaken as preliminary programming for the design of repositioned Family and Consumer Sciences classrooms in public secondary education. Following a photo-ethnographic protocol, data were collected by student researchers participating in FCS secondary classes. Analysis of the student data yielded three major areas of concern. Students felt a need to modify material dimensions of their context to provide more emotional support in the classroom. They also identified a need for material modifications to provide better physical support. Further, they wished to manipulate the social dimension to enhance emotional states. Meta-analysis of existing research among adult stakeholder groups identified potential constraints. Although there was a significant trend toward learner-centered education and nurturing support among educational philosophers, other adult stakeholder groups tend not to have adopted a learner-centered viewpoint. Control, budget issues, ease of maintenance, energy efficiency, flexible space utilization,

content delivery, technology, and even social and political ideology were among the criteria driving real-world design and installation of educational spaces. With both the ideal and current constraints identified, programming is now available to guide further design process. #

c) Source of Funding: Hatch, State

d) Scope of Impact: Integrated research and extension

B. Stakeholder Input Process

Most stakeholder input has been collected in conjunction with West Virginia University Extension (administratively distinct from the College of Agriculture, Forestry and Life Sciences) since we share a large majority of stakeholders. We discontinued special meetings which had the gathering of stakeholder input as their sole purpose, and instead, have relied on input gathered at meetings with other primary purposes (annual or regular meetings of West Virginia Farm Bureau, West Virginia Forestry Association, West Virginia Grasslands Steering Committee, State Aquaculture Forum, Organic Research Project annual meeting, etc.). We find the new procedure much more efficient and, when suggestions from all meetings are combined, to represent a much larger and more diverse segment of our stakeholders.

Input also originates from various advisory groups associated with specific interest areas within College Divisions (e.g., Organic Research Project Steering Committee within the Division of Plant and Soil Sciences; Appalachian Hardwood Council Advisory Board in the Division of Forestry, etc.) as well as from advisory groups established at the College/Station level (Davis College Visiting Committee; Experiment Station Advisory Board). Examples ranging from the very specific (Organic Research Project Steering Committee) to the very broad (Experiment Station Advisory Board) will serve to illustrate the process.

The Organic Research Project has a Steering Committee of organic producers chosen by the Mountain State Organic Growers and Buyers Association. The Steering Committee, with members from West Virginia, Pennsylvania and Maryland, meets twice yearly to review planned research, develop new research areas, suggest changes to improve farming systems and production practices. The Committee also helps communicate results to other growers.

A majority of suggestions from the Steering Committee are suggestions of research projects which are thought likely to contribute to producer profitability. Examples of suggestions from the Steering Committee acted upon by the project team include suggestions to conduct research trials to investigate the impact of growing disease resistant and susceptible varieties as companion plantings, to study control of insects using compost tea, to compare yields from monocultures and from companion plantings of differing species. A more recent recommendation, which will be acted upon beginning in the coming growing season, is to develop and distribute cost-of-production and income

budgets for individual vegetables in addition to those for the entire "market garden" as has been the past practice.

The West Virginia Agriculture and Forestry Advisory Board is appointed based on suggestions originating from Divisions in the College to represent the broad range of industries and disciplines served by the Davis College and West Virginia Experiment Station. The Board meets twice annually with an agenda focused on research issues but which quickly broadens to include many academic and outreach concerns which are linked to research. Examples of suggestions from the Advisory Board which have been adopted or currently being considered by College administration include, strong encouragement to work with WVU Extension to develop procedures and processes to better integrate College and Extension programs. Additional suggestions have been to focus on fewer research areas in the College/Station; to incorporate a list of questions provided by the Board to assist faculty in preparing research reports, and to anchor our Station Plan of Work for 2007 – 2011 on clearly defined and uniformly understood vision and mission statements from the College/Station and from each Division in the College.

C. Program Review Process

There have been no changes in the merit review process from that indicated in the Plan of Work.

D. **Evaluation of the Success of Multi and Joint Activities**

Personnel from the West Virginia Station participated in 9 Northeastern, four Southern, one Western and one Northcentral regional projects during 2005. Subject matter addressed ranged from breeding improved forage crops (for feed and/or biomass), to developing TMDL assessment tools, to management of wildlife damage, to determining impacts of out-of-school experiences on youth development.

West Virginia scientists participate in two Southern regional projects designed to identify, remediate and protect water resources. S-1004 is testing the reliability of various models to develop TMDL standards in agricultural watersheds as well as methods to evaluate existing situations and provide remediation where necessary, considering both biologic and economic variables. Project S-297 is investigating a variety of techniques to distinguish human vs. livestock vs. wildlife fecal contamination to more quickly identify and eliminate sources of contamination. The latter project also is identifying microbial agents which either biodegrade or enable plant uptake of chemical contaminants. Both of these projects are extremely important for economic development and quality of life in West Virginia.

Multi-state projects relevant to specific, economically important plant commodities in West Virginia include projects to evaluate new apple cultivars, to control (extend or shorten) flowering and seed set periods in horticultural plants, and to develop biologically based IPM systems for the management of plant parasitic nematodes as well as oak and chestnut pathogens. Production of horticultural crops, including tree fruits and especially apples, represent areas of potential economic growth for West Virginia stakeholders. Evaluation of yield and quality for apple cultivars relevant to specific geographic areas

and conditions, and the selection of those best suited for specific micro-environments, has enabled regional and national producers to remain globally competitive, keeping prices low for consumers without sacrifice of product quality.

The abundant wildlife in West Virginia is both an asset and potential liability. Property and personal damage from deer, bear, geese and other species are increasing rapidly in frequency and cost. West Virginia participates in NE-1005, *Management of Wildlife Damage in Suburban and Rural Landscapes*, which seeks to document and minimize damage to individuals and property from excessive contact with wildlife. Cooperation among researchers from seven northeastern states recently has assessed the impact of Sunday hunting on annual deer kill, developed and tested methods for dispersing Canada geese, significantly reduced repeat offending nuisance bears, and studied feasibility of controlling fertility in white-tailed deer.

Plant parasitic nematodes and Chestnut blight represent chronic and acute problems, respectively, having extreme economic consequences. Compounding these problems are growing stakeholder concerns with the use of synthetic pesticides to control plant pests and diseases. Alternative control options, such as breeding of resistant plant strains, improved cultural practices, mating disruption and the identification/introduction of pest predators, are ensuring more sustainable and environmentally friendly crop production systems while reducing pesticide exposure risks.

Multi-state research projects involving pasture-based production systems for beef, sheep and dairy; projects related to animal waste management and those developing methods for more efficient reproduction in pasture maintained livestock, are of key importance in enabling West Virginia producers to capitalize on abundant state grasslands. Again many of the stakeholders in these projects represent low income, rural and often underserved citizens seeking to supplement family income with a relatively low-intensity agricultural operation. The low cost production and improved marketing systems being evaluated in these projects, as well as the reproductive and animal waste management programs which have been developed, have the potential to contribute markedly to the economic growth of our rural communities.

Joint, integrated research and extension activities have been a central focus at West Virginia University during the past several years. Integrated projects span all divisions of the College (Animal and Veterinary Sciences, Family and Consumer Sciences, Forestry, Plant Sciences and Resource Management) with the most mature and extensive examples being the aquaculture and organic farming projects discussed in Program 1. The aquaculture project is a multidisciplinary, multi-college, multi-institutional integrated project to develop food fish and recreational fishing industries in the state with continued research involvement by faculty at West Virginia State (West Virginia's 1890 Land Grant), and Bluefield State Colleges. The direction of focus for this project is from the ultimate user to the technology delivery to the technology development, with needs of the first defining the structure of latter two. Similarly, the organic farming project involves both Davis College and WVU Extension faculty in horticulture, agronomy, plant physiology, soil science, entomology, plant pathology, and economics in a holistic, user

centric approach to sustainable production. Additional examples of integrated activities include joint programs to foster increased use of abundant, low cost grasslands for the pasture production of beef, sheep and dairy; research and extension programs to support an expanding poultry industry; and coordinated efforts with farmers, foresters and the general public to improve state water quality.

E. Integrated Research and Extension Activities

Program expenditures listed in Appendix C are described briefly as follows:

1. ***Pasture Production of Livestock*** involves research and technology transfer related to developing superior strains of grass; eliminating the toxic effect of the endophyte fungus; devising more profitable livestock management systems for beef, sheep and dairy; pasture finishing of beef; improving animal marketing systems; and producing 0economic data, budgets and forecasts which enable profitable enterprises.
2. ***Competitive Poultry Industry*** includes research and technology transfer to enhance poultry growth rate and efficiency, improve product quality and safety, anticipate market trends and changes, and responsibly dispose of animal waste.
3. ***Improve Water Quality*** is a state-wide, integrated effort to improve water quality actually or potentially compromised by acid mine drainage, improper animal waste management and poorly maintained septic systems.
4. ***Manage Forest Resource Pests*** is focused on developing and implementing effective, economically feasible, sustainable methods of managing damage to hardwood forests from insects, diseases and invasive species.
5. ***Improve Reproduction in Livestock*** develop and support integrated management systems which contribute to increased reproductive efficiency for beef and sheep producers.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated Activities
(Attach Brief Summaries)

Fiscal Year: 2005

Select One: ☐ **Interim** ☐ **Final** Final

Institution: West Virginia University

State: West Virginia

	Integrated Activities (Hatch)	Multistate Extension Activities (Smith-Lever)	Integrated Activities (Smith-Lever)
Established Target %	25%	%	%
This FY Allocation (from 1088)			
This FY Target Amount	$620,260		
Title of Planned Program Activity			
Pasture Livestock Production	$113,899		
Competitive Poultry Industry	243,742		
Improve Water Quality	268,560		
Manage Forest Resource Pests	160,287		
Improve Reproduction in Livestock	467,492		
Total	$1,253,980		
Carryover			

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

Director **Date**