

# Cary Lee Rivard

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## EDUCATION

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### **Doctor of Philosophy in Plant Pathology** (expected) Aug 2010

*Department of Plant Pathology, North Carolina State University. Raleigh, NC*

Advisors: Frank J. Louws and H. David Shew

Dissertation Title: "The physiology and application of tomato grafting for field and high tunnel production"

GPA: 3.80

### **Master of Science in Plant Pathology** May 2007

*Department of Plant Pathology, North Carolina State University. Raleigh, NC*

Advisor: Frank J. Louws

Dissertation Title: "Grafting Tomato to Manage Soilborne Diseases and Improve Yield in Organic Production Systems"

GPA: 3.82

### **Bachelor of Science** May 2004

Agricultural Sciences major with concentration in horticulture

Biology major with concentration in plant physiology

Truman State University, Kirksville, MO

Advisors: Mark R. Campbell and Daniel Hite

MOSTARS Bright Flight Scholar

GPA: 3.10

## TEACHING ACTIVITIES

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### TEACHING ASSISTANTSHIPS

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#### **Graduate Teaching Assistant and Lab Coordinator** (Fall 2008)

*Dept of Plant Pathology, NC State University, Advisor: H. David Shew*

Principles of Plant Pathology (PP 315)

- Coordinated lab prep and setup with other TAs, technician, and faculty mentor
- Constructed and coordinated grading of final lab practical
- Coordinated grading and online gradebooks for three lab sections
- Gave weekly introductory lectures in lab
- Carried out two 75-minute classes during lecture section
  - "Principles of Disease Management: Intro, Regulatory and Cultural Control"
  - "Principles of Disease Management: Host Resistance"
- Co-moderated two on-line Elluminate® review sessions for DE section
- Assisted with development and revision of PP 315 lab notebook

## TEACHING ACTIVITIES (continued)

### Graduate Teaching Assistant

(Fall 2007)

*Dept of Plant Pathology, NC State University, Advisor: H. David Shew*  
Principles of Plant Pathology (PP 315)

- Assisted with lab preparation, setup, and development of lab practicals
- Constructed and graded weekly lab quizzes
- Maintained online lab section gradebooks for three lab sections
- Assisted with lecture videotaping and conversion to Authorpoint® presentations for DE section

### Graduate Teaching Assistant and Lab Coordinator

(Spring 2005)

*Dept of Biological Sciences, NC State University, Advisor: Miles D. Engell*  
Introductory Biology I (Bio 181)

- Organized and oversaw lab preparations for 15 BIO 181L sections
- Served as instructor for one BIO 181L section (see duties listed below)
- Assisted with class role and grading for lecture section of >200 students

### Graduate Teaching Assistant

(Fall 2004)

*Dept of Biological Sciences, NC State University, Advisor: Anita P. Flick*  
Introductory Biology I (Bio 181)

- Served as instructor for two BIO 181L laboratory sections
  - Prepared and delivered lectures pertaining to weekly labs
  - Instructed and oversaw lab procedures during class
  - Constructed and graded assignments relevant to daily lab activities
- Assisted with class role and grading for lecture section of >200 students

### Undergraduate Teaching Assistant

(2001-2004)

*Dept of Agricultural Sciences, Truman State University, Advisor: Mark R. Campbell*  
Crop Production Systems (AGSC 210)

- Graded assignments and oversaw weekly lab activities

Introduction to Agriculture (AGSC 101)

- Graded assignments and oversaw weekly lab activities

## GUEST LECTURES

### Food Production in Greenhouses and High Tunnels (HS 453)

(Spring 2009)

*Dept of Horticultural Sciences, North Carolina State University, Instructor: Mary M. Peet*

- "High Tunnels and Grafting for Organic Tomato Production"
- "Tomato Grafting Technique and Cultural Management"

### Organic Disease Management and Farm Tour (HS 492)

(Summer 2007)

*Dept of Horticultural Sciences, North Carolina State University, Instructor: Frank J. Louws*  
*CEFS Summer Internship Program, Center for Environmental Farming Systems*

- "Tomato Grafting to Manage Soilborne Diseases in Tomato"
- Gave field tour at Peregrine Farm, and led discussion regarding techniques and approaches to on-farm research

## TEACHING ACTIVITIES (continued)

### **Greenhouse Food Production (HS 590C)** (Spring 2007)

*Dept of Horticultural Sciences, North Carolina State University, Instructor: Mary M. Peet*

- “Tomato Grafting to Manage Soilborne Diseases in Tomato”
- “Tomato Grafting: Benefits, Tips, and Techniques”

### **Vegetable Food Production (HS 431)** (Fall 2006, 2007)

*Dept of Horticultural Sciences, North Carolina State University, Instructor: Mary M. Peet*

- “Diagnosis and management of soilborne diseases in tomato through grafting”
- Prepared and led subsequent tomato grafting lab

## UNDERGRADUATE MENTORING

### **Seth Avis and Ryan Faulk – CEFS Research Internship Program** (2008)

- “Grafting with dwarf rootstock to alter plant growth in heirloom tomato”
- Assisted interns with experimental design, analysis, and presentation.
- Successfully trained students on tomato grafting technique, disease evaluation, data collection, and cultural management of organic heirloom tomato

### **Amanda McWhirt – CEFS Research Internship Program** (2007)

- “Integrated pest management for organic heirloom tomato production”
- Fostered an independent IPM scouting program and assisted with implementation and experimental design in field research trials
- Successfully trained student on tomato grafting technique, disease evaluation, data collection, and cultural management of organic heirloom tomato

### **Tristan Underwood – Dept of Biology Undergraduate Research Project** (2006)

- “Growth and nutrient uptake of grafted and non-grafted heirloom tomato”
- Provided guidance on basic experimental design and analysis for study
- Successfully trained student on tomato grafting technique and initiated greenhouse assays evaluating rootstock for ability to increase plant vigor and nutrient uptake

### **Amanda Watson and Patsy Wilson – CEFS Summer Internship Program** (2005)

- “Grafting Heirloom Tomato for Increased Productivity on the Organic SFU”
- Guided interns on experimental design, analysis, and maintenance of research plot
- Successfully trained interns on tomato grafting technique and initiated greenhouse assays evaluating rootstock for bacterial wilt resistance

## PROFESSIONAL EXPERIENCE

### **CALS Graduate Student Professional Development Workshop.** Chapel Hill, NC (2009)

- Invited three-day developmental workshop for advanced doctoral students

### **A Statistical Workshop on Linear Regression.** Portland, OR (2009)

- Workshop at American Phytopathological Society annual meeting

### **Preparing the Professoriate Teaching Fellowship.** Raleigh, NC (2008)

- NCSU developmental program focused on teaching and mentoring
- Faculty Teaching Mentor: H. David Shew

## PROFESSIONAL EXPERIENCE (continued)

- The Land Institute.** Salinas, KS (2003)
- Short-course based upon sustainable agriculture and perennial crops
- Center for Environmental Farming Systems.** Goldsboro, NC (2002)
- Internship program through NCSU focusing on sustainable agriculture
  - Learned and carried out organic vegetable production at the small farm unit
  - Attended daily lectures and field tours focusing on sustainable production
  - Carried out independent research project and presented results at CEFS field day
- Bailey Nurseries Internship.** Yamhill, OR (2001)
- Internship surrounding ornamental nursery production and business.
  - Carried out field activities and toured various nurseries in the Willamette Valley
  - Worked independently with Ping Lim in the rose breeding program
- Nick's Greenleaf Gardens.** Kansas City, MO (1991-2000)
- Duties included all aspects of retail production facility: plant propagation, transplanting, watering, pest and disease management, grounds maintenance, landscaping, customer relations, and equipment and greenhouse maintenance

## RESEARCH ACTIVITIES

### RESEARCH EXPERIENCE

- Graduate Research Assistant** (2005-currently)  
*Dept of Plant Pathology, North Carolina State University, Raleigh, NC.*
- Established tomato tube-grafting protocol and developed facilities for grafting
  - Successfully coordinated 30 on-farm and research station field plots in NC and PA
  - Identified rootstocks resistant to bacterial wilt (*R. solanacearum*)
  - Identified rootstocks resistant to fusarium wilt (*F. oxysporum* f.sp. *lycopersici*)
  - Identified rootstocks resistant to root-knot nematodes (*Meloidogyne* spp.)
  - Identified rootstocks resistant to southern blight (*S. rolfsii*)
  - Characterized optimum cultural methods for grafted tomato production
  - Developed budgets for grafting based on two on-farm production facilities
  - Constructed and maintained high tunnels and field plots for "systems" comparison
  - Established and maintained HOB0® environmental data logging equipment
  - Compared environment, disease, crop yield, and fruit disorders in high tunnel vs open-field production for organic heirloom tomato
  - Identified optimum cultural methods for high tunnel production in Eastern NC
  - Developed real-time PCR protocol to study systemic *PIN II* expression in tomato
  - Characterized time-course of *PIN II* expression in tomato as a result of grafting
  - Assisted with semi-annual soil sampling and processing in long-term "systems" research at CEFS for examination of microbial soil communities
  - Assisted with basic disease diagnosis and culture of tomato pathogens and subsequent recommendations in the NCSU Plant Disease and Insect Clinic
  - Assisted with field trials on strawberry, pepper, melon, squash, and tomato crops
  - Advisor: Frank J. Louws

## RESEARCH ACTIVITIES (continued)

### **Undergraduate Research Assistant** (2003)

*Department of Biology, Truman State University, Kirksville, MO.*

- “Development of a habitat suitability model for the federally-threatened Missouri bladder-pod (*Lesquerella filiformis*) at two spatial scales”
- Assisted with field data collection
- Advisor: Michael Kelrick

### **CEFS Undergraduate Research Assistant** (2002)

*Dept of Plant Pathology, North Carolina State University, Raleigh, NC.*

- “Growth rates and soil microbial communities in organic and conventional treatments of *Cucumis sativa*”.
- Used PCR-based DNA fingerprinting and standard dilution plating techniques to study diversity and population of soil bacteria
- Independent research project through CEFS Sustainable Agriculture Internship
- Advisor: Frank J. Louws

### **Undergraduate Research Assistant** (1999-2002)

*Department of Agricultural Sciences, Truman State University, Kirksville, MO.*

- Breeding program for high amylose content maize
- Assisted with collection, organization, and analysis of germplasm
- Conducted amylose content tests in maize kernels using various techniques
- Advisor: Mark R. Campbell

## GRANTS AWARDED

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### **2008 Northeast Region SARE Producer Grant** (\$9,976)

- “An economic comparison of grafted tomato transplant production and utilization in multi-bay high tunnels”
- **Technical Advisor** - Provided experimental design and analysis and contributed significantly to proposal and report preparation. Gave technical support to PA transplant grower who successfully produced ~10,000 grafted transplants.

### **2007 Northeast Region SARE Producer Grant** (\$5,992)

- “Grafting tomatoes in multi-bay high tunnels to overcome soilborne diseases”
- **Technical Advisor**- Provided experimental design and analysis and contributed significantly to proposal and report preparation. Trained PA collaborators on yield data collection and provided grafted transplants for research trial.

### **2007 Organic Farming Research Foundation Research Grant** (\$11,174)

- “Grafting tomatoes on disease resistant rootstocks in small-scale organic systems”
- **Co-Primary Investigator** – Contributed significantly to proposal and report preparation and experimental design and analysis. Carried out disease ratings and trained collaborating grower on yield data collection and grafting method.

## RESEARCH ACTIVITIES (continued)

### 2006 Southern Region SARE Research and Education Project (\$193,000)

- “Grafting rootstocks onto heirloom and locally adapted tomato selections to confer resistance to root-knot nematodes and other soilborne diseases and to increase nutrient uptake efficiency in an intensive farming system for market gardeners”
- **Project Collaborator** – Contributed significantly to experimental design and analysis. Assisted with revision and preparation of proposal and reports.

### 2005 SR-SARE Graduate Student Grant in Sustainable Agriculture (\$10,000)

- “Inducing disease resistance and increased production in organic heirloom tomatoes through grafting”
- **Primary Investigator**

## PUBLICATIONS AND PRESENTATIONS

### LIST OF PUBLICATIONS

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#### Refereed Journals

Rivard, C.L., S. O’Connell, M.M. Peet, and F.J. Louws. 2009. Grafting tomato provides effective management for southern blight and root-knot nematodes. *Submitted to Plant Disease*.

Rivard, C.L. and F.J. Louws, 2008. Grafting to manage soilborne diseases in heirloom tomato production. *Hortscience* 43:2104-2111.

#### Proceedings

Rivard, C.L., S. O’Connell, M.M. Peet, and F.J. Louws. 2008. Grafting as a viable tool to manage major soilborne diseases in the SE-USA. *Proceedings from the 2008 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions*. Orlando, FL USA.

Rivard, C.L. and F.J. Louws, 2007. Disease management and crop productivity utilizing grafted tomatoes. *Proceedings from the 2007 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions*. San Diego, CA USA.

Rivard, C.L. and F.J. Louws, 2006. Grafting: An integrated approach for soilborne disease management. *Proceedings from the 21<sup>st</sup> Annual Tomato Disease Workshop*. Fletcher, NC USA.

#### Meeting Abstracts

Rivard, C.L., S. O’Connell, M.M. Peet, and F.J. Louws. 2009. Grafting tomato with inter-specific rootstock provides effective management for southern blight and root-knot nematodes. *Phytopathology* 99:S109

## PUBLICATIONS AND PRESENTATIONS (continued)

### Meeting Abstracts (continued)

Rivard, C.L., F. J. Louws, S. O'Connell, C. Harlow, and M.M. Peet. 2009. The grafted tomato system: Are there advantages in the presence of soilborne diseases. *Hortscience* 44:1111-1112

O'Connell, S., M.M. Peet, C.L. Rivard, C. Harlow, and F. J. Louws. 2009. The grafted heirloom tomato system for organic production in high tunnels: Are there advantages in the absence of soilborne diseases. *Hortscience* 44:1056.

Peet, M.M., S. O'Connell, C.L. Rivard, C. Harlow, and F. J. Louws. 2009. Physiological disorders in grafted heirloom tomatoes grown in high tunnels using organic production. *Hortscience* 44:979.

Rivard, C.L., F. J. Louws, M.M. Peet, and S. O'Connell. 2008. High tunnels and grafting for disease management in organic tomato production. *Phytopathology* 98:S133

Rivard, C.L. and F.J. Louws, 2007. Induction of the jasmonic acid pathway and elevation of proteinase inhibitor II (*PIN II*) expression as a response to tomato grafting. *Phytopathology* 97:S99.

Rivard, C.L. and F.J. Louws, 2007. Grafting for soilborne disease management in organic heirloom tomato production. *Phytopathology* 97:S99.

Rivard, C.L. and F.J. Louws, 2006. Grafting provides a multi-strategic management tool for heirloom tomato production systems. *Phytopathology* 96:S98.

### Extension Publications

Rivard, C.L. and F.J. Louws, 2007. Research report: Tomato grafting for organic heirloom production. *Inside CEFS*. Winter 2007. Center for Environmental Farming Systems.

Rivard, C.L. and F.J. Louws, 2006. Grafting for disease resistance in heirloom tomatoes. *Ag-675: Extension Factsheet*. College of Agriculture and Life Sciences, North Carolina Cooperative Extension Services.

### PRESENTATIONS

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**American Phytopathological Society** – 08/03/2009. Portland, OR

- “Grafting tomato with inter-specific rootstock provides effective management for southern blight and root-knot nematodes”

**6<sup>th</sup> Annual Int'l Integrated Pest Management Symposium** – 03/25/09. Portland, OR

- “High tunnels and grafting provide complementary IPM strategies for organic tomato production”

**NCSU Graduate Student Research Symposium** – 03/18/09. Raleigh, NC

- “Grafting with inter-specific rootstock provides novel applications for host resistance in tomato”

## PUBLICATIONS AND PRESENTATIONS (continued)

**CEFS High Tunnel Workshop** – 02/17/09. Goldsboro, NC

- “Modification of microclimates in high tunnels: A case study at CEFS”
- “Diagnosis and management of diseases in high tunnels”

**First Annual NCSU Plant Pathology PhD Symposium** – 09/28/08. Raleigh, NC

- “Grafting for soilborne disease management in organic heirloom tomato production”

**American Phytopathological Society** – 07/28/2008. Minneapolis, MN

- “High tunnels and grafting for disease management in organic tomato production”

**20<sup>th</sup> Anniversary National SARE Conference** – 03/26/2008. Kansas City, MO

- “Grafting rootstocks onto heirloom and locally-adapted tomato selections to confer resistance to soilborne diseases and increase nutrient uptake for market gardeners”

**22<sup>nd</sup> Annual Tomato Disease Workshop** – 10/26/2007. Williamsburg, VA

- “Grafting and high tunnel tomato research”

**Seasons of Sustainable Agriculture Fall Festival** – 10/15/2007. Goldsboro, NC

- “CEFS organic heirloom tomato research”
- “Tomato grafting workshop”

**CEFS Tomato Grafting Workshop** – 10/03/2007. Goldsboro, NC

- “Diagnosis of soilborne diseases in tomato”
- “Soilborne disease management and defense gene expression in tomato by grafting”
- Participants were given hands-on training in grafting technique

**American Phytopathological Society** – 07/30/2007. San Diego, CA

- “Elevation of proteinase inhibitor II expression in tomato as a response to grafting”
- “Grafting for soilborne disease management in organic heirloom tomato production”

**NCSU Dept of Plant Pathology Master’s Symposium** – 12/08/2006. Raleigh, NC

- “Soilborne disease management and defense gene expression through tomato grafting”

**21<sup>st</sup> Annual Tomato Disease Workshop** – 11/09/2006. Fletcher, NC

- “Grafting: An integrated approach for soilborne disease management”

**Seasons of Sustainable Agriculture Fall Festival** – 10/16/2006. Goldsboro, NC

- “Tomato grafting booth”

**National SARE Conference** – 08/16/2006. Oconomowoc, WI

- “Grafting provides sustainable and profitable technology in organic heirloom tomato production systems”

**American Phytopathological Society** – 07/30/2006. Quebec City, Canada

- “Grafting provides a multi-strategic management tool for heirloom tomato production systems”

**NCSU Dept of Plant Pathology Master’s Symposium** – 11/18/2005. Raleigh, NC

- “Using grafting to induce disease resistance and increase yields in heirloom tomato production systems”

## PUBLICATIONS AND PRESENTATIONS (continued)

**Carolina Farm Stewardship Assoc Sustainable Ag Conf** – 11/05/2005. Durham, NC

- “Inducing disease resistance and increased yields in heirloom tomato production systems through grafting”

### INVITED PRESENTATIONS

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**University of Georgia Heirloom Tomato Grafting Workshop** – 03/03/09. Athens, GA

- “Benefits of grafting for heirloom tomato production”
- “Grafting technique and demonstration”

**Lehigh-Burke County Vegetable Conference** – 02/13/09. Fleetwood, PA

- “Grafting tomato for soilborne disease management”

**Mid-Atlantic Fruit and Vegetable Convention** – 02/04/2009. Hershey, PA

- “Tomato grafting, rootstock selection, and cultural management”

**Haygrove High Tunnels Owners’ Conference** – 12/05/2008. Lancaster, PA

- “Grafting tomatoes in multi-bay high tunnels to overcome soilborne diseases”
- “Tomato grafting technique and demonstration”

**2008 Chatham County Tomato Grafting Workshop** – 11/12/2008. Pittsboro, NC

- “Choosing rootstock for soilborne disease management”
- “Case study: High tunnel and grafting research at CEFS”
- Participants were given hands-on training in grafting technique

**2008 USDA Panel Discussion on Vegetable Grafting** – 11/10/08. Ft Pierce, FL.

- Roundtable discussion with international panel on US adoption/integration of grafting and importance for Methyl Bromide Alternatives

**National Extension Agents Conference** – 07/15/2008. Greensboro, NC

- “Grafting heirloom tomatoes for disease resistance in intensive farming systems”
- SARE-sponsored lunch seminar showcasing SR-SARE research projects.

**Truman State University Agricultural Sciences Dept** – 03/28/2008. Kirksville, MO

- “Tomato grafting: A sustainable tool for disease management and a novel application for induced resistance”

**Organic Growers School** – 03/08/2008. Flat Rock, NC

- “Grafting for soilborne disease management”

**22<sup>nd</sup> Annual Southeast Vegetable & Fruit Expo** – 12/13/2007. Myrtle Beach, SC

- “Using high tunnels and organic practices to produce grafted heirloom tomatoes”

**Carolina Farm Stewardship Assoc Sustainable Ag** – 11/10/2007. Durham, NC

- “Grafting and high tunnels for organic heirloom tomato production”

**2007 Chatham County Tomato Grafting Workshop** – 03/15/2007. Pittsboro, NC

- “Tomato grafting technique”
- “Soilborne disease management and defense gene expression in tomato by grafting”
- Participants were given hands-on training in grafting technique

## PUBLICATIONS AND PRESENTATIONS (continued)

**Mid-Atlantic Fruit and Vegetable Convention** – 01/31/2007. Hershey, PA

- “Tomato grafting for soilborne disease resistance”

**21<sup>st</sup> Annual Southeast Vegetable & Fruit Expo** – 12/13/2006. Myrtle Beach, SC

- “Tomato grafting: Benefits and techniques of an emerging technology”

**NC CES Regional Greenhouse Workshop** – 02/02/2006. Fletcher, NC

- “Vegetable grafting provides disease management and increased crop productivity for greenhouse production”

### FIELD DAYS

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**MHCR&EC Vegetable Field Day** – 08/11/2009. Mills River, NC

- “Tomato grafting with inter-specific rootstock to manage soilborne diseases”

**Cedar Meadow Farm Field Day** – 07/07/2009. Holtwood, PA

- “Grafting tomatoes in multi-bay high tunnels to overcome soilborne diseases”

**Center for Environmental Farming Systems Spring Festival** – 04/18/09. Goldsboro, NC

- “Organic disease management in the garden”

**Jack Bailey Memorial Disease Tour** – 08/14/2008. Goldsboro, NC

- “High tunnels and grafting for disease management in organic tomato production”

**MHCR&EC Vegetable Field Day** – 08/07/2008. Fletcher, NC

- “Grafting with ‘Maxifort’ as an alternative to methyl bromide for tomato production”

**Cedar Meadow Farm Field Day** – 07/09/2008. Holtwood, PA

- “Grafting tomatoes in multi-bay high tunnels to overcome soilborne diseases”

**Center for Environmental Farming Systems Twilight Tour** – 05/15/08. Goldsboro, NC

- “High tunnels and grafting for organic heirloom tomato production”

**MHCR&EC Tomato Field Day** – 08/03/2006. Fletcher, NC

- “Evaluation of grafted tomato under various management regimes”

**Center for Environmental Farming Systems Field Day** – 07/30/2005. Goldsboro, NC

- “Grafting heirloom tomato seedlings for increased productivity on the organic small farm unit”

## AWARDS AND ACTIVITIES

**2009 North Carolina State University Graduate Student Research Symposium**

- First Place – Agricultural Sciences Division

**2007 Eddie Echandi Student Travel Award**

- “Integrated pest management for tropical plant pathology”
- APS Foundation graduate student travel award

## **AWARDS AND ACTIVITIES (continued)**

### **North Carolina State University Plant Pathology Graduate Student Association**

- 2009 Electronic Arts Officer
- 2008 Vice-President
- 2007 Social Committee
- 2006 UGSA alternative representative

### **Center for Environmental Farming Systems**

- 2009 Spring Festival Plant Booth Coordinator
- 2007 Fall Festival Volunteer Coordinator
- Fall Festival Volunteer 2005-2009

### **American Phytopathological Society**

- Graduate Student Committee
- Served as travel award reviewer in 2008 and 2009.

### **Plant Pathology Society of North Carolina**

### **Carolina Farm Stewardship Association**

### **Sigma Xi Scientific Research Society**

### **Delta Tau Alpha Agricultural Honor Society**