

I. INTRODUCTION

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A. Extension Responsibilities

Dr. Buhler holds a 100% extension appointment in the Department of Horticultural Science and is an Associate faculty member of the Department of Entomology. He is responsible for coordination of the Pesticide Safety Education Program (PSEP) in North Carolina. He was promoted to the rank of Professor in 2010.

The purpose of the Pesticide Safety Education Program is to instruct crop producers, commercial pesticide applicators, and the public on the proper use of pesticides. Educational programs and resources provided through the PSEP are directed mainly toward applicators who use restricted use pesticides that might cause adverse effects on human health or the environment if used incorrectly.

As the Pesticide Education Specialist, Dr. Buhler develops the educational materials that are used for the certification and re-certification (continuing education) of private applicators, commercial applicators, and dealers of restricted-use pesticides. In addition to direct participation in certification education training sessions, Dr. Buhler also instructs County Extension Pesticide Coordinators on methods for delivering these programs at the county level. The PSEP provides training and continuing education for approximately 14,000 private applicators, 18,000 commercial applicators, and 700 pesticide dealers. Approximately 16,000 applicators and dealers attend educational programs sponsored by the NC Cooperative Extension Service each year.

B. Brief Resume

1. Education background:

Ph.D., Entomology. 1991. Purdue University, West Lafayette, IN

Dissertation title: Investigation of the effects of enhanced biodegradation of carbofuran in soils used for muskmelon production. Major Professor: Alan York, Ph.D.

M.S., Entomology. 1986. Purdue University, West Lafayette, IN

Thesis title: Development of a pest management sampling plan for the meadow spittlebug on alfalfa. Major Professor: M. Curtis Wilson

B.A., Biology. 1983. Anderson University, Anderson, IN

2. Professional experience:

2011 to present Prof./Asst. Dept. Head/Extension Specialist, Dept. Horticultural Science, NCSU

2010 to present Professor/Extension Specialist, Dept. Horticultural Science, NCSU

2004 to 2010 Associate Professor/Extension Specialist, Dept. Horticultural Science, NCSU

2000 to present Director, Southern Region Pesticide Safety Education Center, NCSU

- 1998 to 2004 Assistant Professor/Extension Specialist, Dept. Horticultural Science, NCSU
- 1996 to 1998 Ind./Ill. Coordinator, Area-wide Corn Rootworm Project, Dept. Entomology, Purdue Univ.
- 1993 to 1996 Extension Associate, Dept. Entomology, Purdue Univ.
- 1991 to 1993 Post-doctoral Research Associate, Dept. Entomology, Purdue Univ.

3. Scholarly and creative activities:

Refereed activity	Number
Journal articles	20
Book chapters	9
Extension pubs.	32

Non-refereed activity	Number
Research abstracts	61
Proceedings	17
Posters	20
Extension pubs.	36
Manuals	18
Other publications	46
Workshops hosted	35
Guest lectures	45

Grants: 30 totaling \$870,022

Receipts and programmed funds: \$1,368,766

4. Membership in professional organizations:

- American Association of Pesticide Safety Educators
- American Chemical Society
- American Society of Agricultural and Biological Engineers
- American Society for Horticultural Science
- Council for Agricultural Science and Technology
- Entomological Society of America
- Epsilon Sigma Phi (Cooperative Extension)
- International Association for the Plant Protection Sciences
- National Association of County Agricultural Agents
- North Carolina Crop Protection Association
- North Carolina Entomological Society
- North Carolina State Grange
- The Pesticide Stewardship Alliance
- Turfgrass Council of North Carolina
- Weed Science Society of North Carolina

5. Scholarly and professional honors (since 2001):

- 2011 Program Innovation Award from The Pesticide Stewardship Alliance (TPSA). Recognition for the development of the Southern Region Pesticide Safety Education Center and The Pesticide Environmental Stewardship website

Appointed by Ag. Commissioner, Steve Troxler, to the Interagency Pesticide Workgroup, NC State Cooperative Extension Service Representative. 2010-present.

Appointed by US EPA Administrator Lisa Jackson to the Pesticide Program Dialogue Committee, An Advisory Committee to the Office of Pesticide Programs (2010-present)

Inducted into the NC Chapter of Gamma Sigma Delta, The Honor Society of Agriculture, March 2010.

2009 North Carolina State Grange Search for Excellence Award. For outstanding work as an Extension Specialist. \$800 award

Ort Family Scholarship Award for Outstanding Cooperative Extension Personnel on behalf of extension education for the NC Association of County Agricultural Agents. 2009. \$100 award.

Ort Family Scholarship Award for Outstanding Cooperative Extension Personnel for Outstanding Cooperative Extension Service Specialist Award. 2009. \$100 award.

Mid-Career Service Award, Epsilon Sigma Phi, Xi Chapter, North Carolina Cooperative Extension Service Professionals' Organization. Recognizing excellence in 10-20 years of career. 2009.

Mr. Dennis Carey received first place in the Bryson James M.S. Student Research Competition at the 2008 Southern Nursery Association. B. Whipker and W. Buhler co-chairs graduate advisory committee.

Appointed by Governor Easley to serve on a nine-member Task Force on Preventing Agricultural Pesticide Exposure in North Carolina, 2008.

Outstanding Book Award, American Society for Horticultural Science, Extension & Industry Division. 2005.

Blue Ribbon Extension Communication Award, American Society for Hort. Sci.-Southern Region. 2005.

Agricultural Pesticide Recordkeeping Manual created by Wayne Buhler and colleagues at the NCDA&CS was chosen by Bonnie Poli, Chief, Recordkeeping Branch of the USDA for national distribution. 2004.

Early Career Service Award. Epsilon Sigma Phi, Xi Chapter, North Carolina Cooperative Extension Service Professionals' Organization. Recognizing excellence in first 10 years of career. 2003.

Walton S. Dennis Award for Environmental Stewardship. Crop Protection Assoc. of NC. 2003.

Outstanding Extension Publication Award, American Society for Horticultural Science. 2003.

Pride of the Wolfpack Award, College of Agriculture and Life Sciences, NCSU. 2003.

The NC Pesticide Safety Education Program was selected by the USDA National Program Leader as one of four state programs highlighted in the 2001-2002 USDA CSREES Annual Report. 2003.

Make a Difference Award, American Association of Pesticide Safety Educators. Recognition for creating the Southern Region Pesticide Safety Education Center. 2001.

6. Professional service on campus:

North Carolina Agricultural Chemicals Manual Editorial Committee (1998- present); Chair 2006

Crop Protection School Planning Committee (1998-present); Chair, 2000

Pest Management Information Program Advisory Committee (2003-2009)

IPM Mini-grants Review Board (2008-2010)

Pesticides and Human Health Fact Sheet Advisory Committee 2008

Dept. of Hort. Sci.-Dept. Advisory Committee (2004-2005, 2007- present)

Dept. of Hort. Sci.-Staff Recognition Committee (2003 to 2005); Chair (2004-2005)

Dept. of Hort. Sci.-Social Committee (1998 to 2002, 2006); Chair (1999-2000)

Dept. of Hort. Sci.-Safety Committee (2002-2011); Chair (2004-2005, 2008-2010)

Dept. of Hort. Sci.-Search Committee for Extension Assoc. in Pesticide Education; Chair 2000

Pesticide Licensing and Training Reporting Committee, Team Leader (1999-2004)

Agricultural Chemicals Policy Advisory Committee (1998-2004)
Faculty Senate, CALS Representative, Grievance Panel (2004-2006)

7. Professional service off campus:

NC Agricultural Health Study Stakeholder Group, Co-Chair (2012-present)
US EPA Pesticide Program Dialogue Committee (2009 to present)
Journal of Pesticide Safety Education, Editorial Board (2002 to present)
Certification and Training Assessment Group (EPA/USDA), Member (2009-2011)
Interagency Pesticide Workgroup, Office of the NC Commissioner of Agriculture, Member (2009)
The Pesticide Stewardship Alliance, Board of Directors (2007-2010)
NC Entomological Society, Treasurer (2009-2010)
Governor's Task Force on Preventing Agricultural Pesticide Exposure (2008)
Pesticide Certification and Training Manager Selection Committee, NCDA&CS (2005)
Crop Protection Association of North Carolina, Advisor to the Board of Directors (1999-present)
Pesticide Container Recycling Grants Committee, NCDA&CS (1999 to present)
Board of Collaborators, NC Agromedicine Institute (1999-present)
NC Agricultural Health Study Advisory Committee (1999-2010)
American Association of Pesticide Safety Educators (AAPSE), Board of Directors (2004 to 2006)
AAPSE Committee on Committees; Member (1998 to 2012); Chair (2000-2004)
Southern Region Pesticide Certification & Training Mtg., Local Arrangements Chair (2004)

Consulting:

Through CropLife America, the Environmental Protection Agency funded the North Carolina Environmental Stewardship Project with Dr. Buhler serving as the Technical Consultant. Between 2005 and 2007, Dr. Buhler used this funding to coordinate the production of 16 fact sheets covering various aspects of on-farm pesticide safety (four of which were also published in Spanish); a Photonovela entitled "Work Smart-Work Safely," published in English and Spanish for horticultural workers; a DVD/CD entitled "Pesticide Safety in the Nursery and Landscape" (10 video modules addressing pesticide safety issues in English and Spanish with management discussion leader guides); and a 70-page Pesticide Applicator's Handbook (English and Spanish versions).

C. Candidate's Statement

I believe that I have been successful in fulfilling my role as a "Coordinator" by addressing the educational needs of a diverse audience with an equally diverse palate of subject matter and delivery methods. My accomplishments have come about through collaborations with NCSU faculty, staff, and students in addition to my colleagues in multiple state and federal agencies.

It has been my primary goal to provide the Extension Agents who serve as County Pesticide Coordinators with premium quality instructional resources and periodic in-service education. I have developed PowerPoint presentations, written materials, videos, and websites that they can use to educate Private and Commercial Pesticide Applicators. Many of these resources are contained in an on-line, password-protected website accessible only by County Extension Agents. The Agents' interest in delivering high quality educational programs has been stimulated by the establishment of the Southern Region Pesticide Safety Education Center (SR-PSEC). SR-PSEC is a training program consisting of an on-line (Internet) tutorial and a 3-day workshop emphasizing hands-on methods for teaching proper pesticide handling (see Section V). These methods have garnered tremendous success

with a clientele (pesticide applicators) that prefers hand-labor activities and has helped the agents become more effective and credible pesticide safety educators.

Since 2005, I have received funds to coordinate and contribute to the Pesticide Environmental Stewardship Website (PES). PES is a portal for all pesticide applicators and homeowners to view and obtain information on the safe use of pesticides (see Section V). Progressive farmers and commercial pesticide applicators could benefit from accessing re-certification training opportunities at their convenience through web-based instruction. These modules will have other distance education applications. The NC PSEP has gained recognition through presentations and posters I have given on PES at national and international professional meetings.

My efforts to expand the PSEP to provide pesticide safety information for the Spanish-speaking population both at home and abroad have been rewarding (see Section V). I have sought funds to translate several pesticide safety resources for our Spanish-speaking clientele. During my 2008 visit to the Escuela Agricola Panamericana (Zamorano) in Honduras, several students expressed an interest in coming to NC State to complete their senior project with me. I provided funding for two students to conduct research on organic pesticides in Dr. Yasmin Cardoza's lab. The students participated as interns in the new Global Training Initiative Program within the CALS International Programs Office. Their research was expanded and published in scientific journals. I hope to facilitate and sponsor this faculty-student linkage here at NC State with more outstanding students from Zamorano.

I remain active in my professional organizations. My colleagues in the American Association of Pesticide Safety Educators and The Pesticide Stewardship Alliance have called on me to chair committees, serve on editorial boards, and participate in the planning for the program agenda at our national meetings. I am honored to have been recently nominated and appointed to serve as a Board member of the national Certification and Training Assessment Group (CTAG) and the Pesticide Program Dialogue Committee (PPDC). CTAG is a 15-member organization focused on maintaining and improving the quality of pesticide training and certification programs in the U.S. The PPDC consists of representatives from government, NGOs, agrochemical industry, and Land Grant Universities whose purpose is to advise the US EPA Office of Pesticide Programs in developing or revising pesticide use regulations.

The core of my program funding is through receipts generated from the sale of training manuals and registration fees for the 18 to 20 two-day Pesticide Schools that I coordinate and conduct throughout the state each year. Prospective commercial and private pesticide applicators and dealers study the manuals and attend these schools to prepare for the licensing exam. Attendance at a Pesticide School is the first encounter that many of these people have with the NC Cooperative Extension Service. Presentations by Extension Agents and Specialists have elicited very positive responses from the attendees. I was particularly pleased by a comment made by a young man at the end of a school recently when he told me that "If I had you for a teacher, I would have stayed in school and learned something."

Grants, receipts, and programmed funding for NC PSEP have been used to support educational programs and resources, as well as salary for an Administrative Assistant, a part-time Extension Associate, and graduate students. My first graduate student, Mrs. Colleen Church completed the Master's in Horticultural Science degree in 2010. Additionally, these funds are used to pay for the periodic assistance of two technical editors, a web developer, a videographer, and undergraduate students. I have also enjoyed collaborating with Dr. Brian Whipker, Extension Floriculture Specialist

in the Department of Horticultural Science, in the research that he and his graduate students have conducted on plant growth regulators. These are important chemicals used in commercial floriculture production and are classified as pesticides by federal and state laws. Brian and I served as Co-chairs on the advisory committee for Mr. Dennis Carey, MS degree graduate. I was a member of the advisory committee (Chaired by Dr. Rick Brandenburg) and supported the research conducted by Ms. Amy Lockwood. Amy completed her MS Degree in Entomology on the sugar cane beetle, a new pest of turfgrass in NC.

I believe that the NC PSEP is having a positive impact on pesticide safety education efforts in North Carolina, nationally, and internationally. Pesticide users are constantly in need of information that addresses new techniques in pest management, advances in application technology, and regulations governing the use of pesticides. I am excited about these challenges and am committed to excellence in the development, delivery, and distribution of educational resources and programs to meet these needs.

I thoroughly enjoy my part-time administrative roles as Assistant Department Head to Dr. John Dole, and as Assistant to the State Program Leader in Agriculture and Natural Resources, Dr. Tom Melton. Details of my responsibilities in these areas are provided at the end of the vitae. The experiences have given me the opportunity to engage in the work of various committees and interact with distinguished professionals in academia, government, and private enterprise. My work as an Extension Specialist and Educator has been enhanced and expanded through these experiences, as well. I look forward to making more substantive contributions through these administrative assignments.

II. TEACHING AND MENTORING OF UNDERGRADUATE AND GRADUATE STUDENTS

A. Teaching Effectiveness

1. Lecturer as Substitute Instructor for Steve Toth (medical leave)-ENT 121 Pesticides and Their Utilization (29 students). Tues./Thurs. 8:30-9:45 am. Fall 2011. I presented 9 lectures (listed below) and arranged for 3 others.

- a. Federal pesticide laws & regulations (Sept. 8)
- b. Pesticide labels and labeling (Sept. 15)
- c. Sources of pesticide and pest management information (Sept. 27)
- d. Pesticide selectivity and modes of action (Sept. 29)
- e. Pesticide certification, licensing, and recordkeeping (Oct. 4)
- f. Principles of pesticide application equipment calibration (Oct. 18)
- g. Field calibration of turfgrass sprayers and spreaders (Oct. 20)
- h. Pesticide decontamination, disposal and spills (Nov. 17)
- i. General principles of IPM (Nov. 29)

2. Evaluation of Teacher Effectiveness- ENT 121, Fall 2011 (27 student responses):

	Instructor receptive	Explained material	Enthusi- astic	Prepared	Useful feedback	Respect- ful	Overall effective	Improved knowledge	Course excellent
Rating	4.7	4.8	4.9	4.8	4.9	4.8	4.9	4.7	4.8

B. Instructional Development

1. Enhanced PowerPoint presentations with hands-on training aids for ENT 121.

2. Co-authored (with S. Toth, Dept. of Entomology) 15 PowerPoint presentations as part of the curriculum for the Agricultural Institute course, ENT 121-Pesticides and Their Utilization (2001-present).

- Pesticide Drift and Phytotoxicity.
- Pesticide Recordkeeping.
- Pesticide Resistance.
- Environmental Concerns for Pesticide Applicators
- Environmental Effects of Pesticides.
- Federal Pesticide Laws and Regulations.
- Fungicides and Nematicides.
- Herbicides.
- Insecticides.
- Personal Safety and Protective Clothing.
- Pesticide Decontamination, Disposal and Spills.
- Pesticide Formulations.
- Pesticide Labels and Labeling.
- Pesticide Transportation and Storage.
- What are Pesticides? Why Use Pesticides?

3. Created curriculum including lecture, worksheet, and hands-on exercise to teach calibration of pesticide application equipment for students in the Agricultural Institute (2005).

4. Created four-page document with guidelines on how to become a certified and licensed pesticide applicator for use by students in the Agricultural Institute (2007).

5. Created Pesticide Safety PowerPoint presentations that were used by Zach Taylor for lecture and lab sections of CS 011(2006-2008). Calibration guides and fact sheets on pesticide regulations were used by Juliana Buckelew for students in HS/CS 717 (2006).

Guest Lectures:

1. AG 195- Pesticide Safety/Certification and Licensing. In: Weeds and Diseases of Ornamentals. Instructor Joe Neal, 30 students.
2. ENT 021- Field Calibration of Turfgrass Sprayers and Spreaders. Oct. 21, 2010. Instructor Steve Toth, 30 students.
3. ENT 021- Principles of Pesticide Application Equipment Calibration. Oct.19, 2010. Instructor Steve Toth, 30 students.
4. ENT 021- Principles of Pesticide Application Equipment Calibration. Oct.20, 2009. Instructor Steve Toth, 35 students.
5. ENT 021- Field Calibration of Turfgrass Sprayers and Spreaders. Oct. 22, 2009. Instructor Steve Toth, 35 students.
6. ENT 021- Pesticide Drift and Phytotoxicity. Oct. 3, 2009. Instructor Steve Toth, 35 students.
7. ENT 021- Pesticide Transportation, Disposal, and Spill Response. Nov. 18, 2008. Instructor Steve Toth, 54 students.
8. ENT 021- Field Calibration of Turfgrass Sprayers and Spreaders. Oct. 23, 2008. Instructor Steve Toth, 54 students.
9. ENT 021- Principles of Pesticide Application Equipment Calibration. Oct.21, 2008. Instructor Steve Toth, 54 students.
10. Agrichemicos (Class for 3rd year Crop Management Majors— Escuela Agricola Panamericana, Honduras). Calibration of Pesticide Application Equipment. Oct. 2, 2008. Instructor Rogelio Trabanino Young, 105 Students.
11. Agrichemicos (See above). Pesticides and Their Proper Use. Oct. 1, 2008. Instructor Rogelio Trabanino Young, 105 Students.
12. ENT 021- Pesticide Decontamination, Disposal, and Spill Response. Nov. 13, 2007. Instructor Steve Toth, 41 students.
13. AGI 010- Pesticide Certification and Licensing. Nov. 5, 2007. Instructor Helen Kraus, 30 students.
14. ENT 021- Field Calibration of Turfgrass Sprayers and Spreaders. Oct. 25, 2007. Instructor Steve Toth, 41 students.
15. ENT 021- Principles of Pesticide Application Equipment Calibration. Oct. 23, 2007. Instructor Steve Toth, 41 students.
16. CS 415 Integrated Pest Management-Understanding Pesticides and Formulations. Sept. 4, 2007. Instructor Mike Burton, 21 students.
17. CS 090 – Certification and licensing in ornamental and turfgrass pest control. Feb. 16, 2007. Instructor Richard Cooper, 62 students.
18. ENT 021- Pesticide Drift and Phytotoxicity. Nov.7, 2006. Instructor Steve Toth, 66 students.
19. PRT 811- Preparing for a career in Extension. Oct. 26, 2006. Instructor Doug Wellman, 6 graduate students.
20. ENT 021- Field Calibration of Turfgrass Sprayers and Spreaders. Oct. 26, 2006. Instructor Steve Toth, 66 students.
21. ENT 021- Principles of Pesticide Application Equipment Calibration. Oct. 24, 2006. Instructor Steve Toth, 66 students.

22. ENT 021- Principles of Pesticide Application Equipment Calibration. Oct. 11, 2005. Instructor Steve Toth, 50 students.
23. ENT 021- Field Calibration of Turfgrass Sprayers and Spreaders. Oct. 13, 2005. Steve Toth Instructor, 50 students
24. ENT 021-Calibration of Pesticide Application Equipment. Oct. 5, 2004. Instructor Steve Toth, 50 students.
25. ENT 021– What is a Pesticide? Why Use Pesticides? Aug. 19, 2004. Instructor Steve Toth, 50 students.
26. ENT 791R – Understanding Pesticide Labeling and Certification. 2003. Instructor Ken Sorensen, 9 students
27. ENT 021-Calibration of Pesticide Application Equipment. 2003. Instructor Steve Toth, 52 students
28. ENT 021-Calibration of Pesticide Application Equipment. 2002. Instructor Steve Toth, 42 students
29. ENT 791R – Pesticide Safety, Labeling and Formulations. 2001. Instructor Ken Sorensen, 5 students
30. ENT 021 – Calibration of Pesticide Application Equipment. 2001. Instructor Steve Toth, 40 students
31. ENT 791R – Pesticide Certification and Training in NC. 2000. Instructor Ken Sorensen, 8 students
32. ENT 021 – Calibration of Pesticide Application Equipment. 2000. Instructor Steve Toth, 45 students
33. ENT 791R - Pesticide Education and Training. 1999. Instructor Ken Sorensen, 10 students
34. CS 053 – Pesticide Applicator Training and Certification. 1999. Instructor Joe Neal, 42 students
35. BAE 432 – Safe Handling of Pesticides. 1998. Instructor Gary Roberson, 16 students
36. ENT 791R – Pesticide Labeling and Formulations. 1998. Instructor Ken Sorensen, 15 students

C. Mentoring Activities

After the 2006 death of Professor Doug Sanders, Vegetable Crop Specialist in Horticultural Science, I provided funding to supplement the salary of his technician, Dr. Luz Reyes. Luz assisted me by providing Spanish translation at two of my speaking engagements. She also helped translate several educational resources. I spent many months working with Luz in the organization, analysis, and publication of one of the last studies she conducted with Dr. Sanders. Doug is recognized posthumously as a co-author of the publication. Luz moved to Indiana with her family in 2007.

I supervised NC State undergraduate students in 2002, 2003, and 2009 who were engaged in website development and editing of pesticide safety education materials. In 2009, I provided financial support and co-directed the research for two undergraduate students from the Escuela Agricola Panamerica, Honduras, who completed their senior year research projects through the Global Training Initiative Program within the CALS International Programs Office.

D. Master's and Doctoral Theses Directed

1. Chair of Graduate Advisory Committee for Colleen Church, MHS (non-thesis) degree. Fall 2010.

2. Co-Chair of Graduate Advisory Committee for Dennis Carey. MS Horticulture. Fall 2008.

E. Graduate Committee Memberships

1. Graduate Advisory Committee for Amy Lockwood. MS Entomology. Fall 2011.

III. SCHOLARSHIP IN THE REALMS OF FACULTY RESPONSIBILITY

1. Accomplishments

A. Publications

Peer-Reviewed Journal Articles

1. Church, C.S., W.G. Buhler, L.K. Bradley, and R.E. Stinner. Assessing Extension educator's needs for the development of homeowner pesticide use and safety information. (Accepted Journal of Extension. 2012).
2. Torres-Barragan, A., A. Suazo, W. Buhler, and Y.J. Cardoza. 2011. Studies on the entomopathogenicity and bacterial associates of the nematode *Oscheius carolinensis*. Biological Control 59: 123-129.
3. Church, C.S., W. Buhler, L.K. Bradley, and R.E. Stinner. Evolution of a pesticide safety website-Cooperative Extension agents help define target audience needs. (Accepted Acta Hort., Feb. 2012).
4. Barnes, J., B. Whipker, W. Buhler, and I. McCall. First- and second-season flurprimidol pre-plant bulb soaks affect growth of Lillium lancifolium cultivars. (submitted to HortTechnology, 2012)
5. Fair, B., B. Whipker, I. McCall, and W. Buhler. Growth control of Salvia microphyla 'Hot Lips' to flurprimidol substrate drenches. (submitted to Journal of Environmental Horticulture, 2012).
6. Whipker, B., I. McCall, J. Barnes, W. Buhler, B. Krug, C. Currey, and R. Lopez. 2011. Flurprimidol pre-plant bulb soaks control growth of potted Liliums. Acta Hort. (ISHS) 900:79-87.
7. Whipker, B., B. Krug, I. McCall, and W. Buhler. 2011. Flurprimidol pre-plant soaks and substrate drenches control excessive plant growth. Acta Hort. (ISHS) 886:383-389.
8. Whipker, B., I. McCall, B. Krug, and W. Buhler. 2011. Flurprimidol pre-plant tuber soaks for dahlia growth control. Acta Hort. (ISHS) 886:391-394.
9. Whipker, B., I. McCall, and W. Buhler. 2011. Control of calla lily growth with flurprimidol pre-plant tuber soaks and substrate drenches. Acta Hort. (ISHS) 886:395-398.
10. Murillo, A.C., R.L. Brandenburg, and W. Buhler. Life history and ecology of the Sugarcane Beetle (Coleoptera: Scarabeidae) in North Carolina turfgrass. (submitted to Applied Turfgrass Science, 2011).
11. Buhler, W.G., D.R. Gardisser, and R.W. Whitney. 2010. Operation S.A.F.E. Fly-in: The North Carolina Experience. Journal of Pesticide Safety Education 12: 1-12.
12. Carey, D.J., B.E. Whipker, I. McCall, and W. Buhler. Effect of benzyladenine foliar sprays on offset production of selected succulents. (Accepted with revision by HortTechnology).
13. Reyes, L.M., D. C. Sanders, and W.G. Buhler. 2008. Evaluation of slow release fertilizers on bell peppers. HortTechnology 18(3): 393-396.
14. Buhler, W.G., R. L. Langley, R.C Luginbuhl, J.P. Jones, and J.W. Burnette, Jr. 2007. Violations of pesticide use and worker safety regulations in North Carolina. Journal of Agricultural Safety and Health 13(2): 189-203

15. Curwin, B., M. Hein, W. Sanderson, M. Nishioka, and W. Buhler. 2005. Nicotine exposure and decontamination on tobacco harvesters' hands. *Annals of Occ. Hygiene Advance* 49(5): 407-414.
16. Buhler, W. and L. Whipker. 2003. Using research to design and evaluate pesticide dealer training. *Journal of Pesticide Safety Education* 5: 7-24.
17. Curwin, B., M. Hein, W. Sanderson, M. Nishioka, and W. Buhler. 2003. Acephate exposure and decontamination on tobacco harvesters' hands. *Journal of Exposure Analysis and Environmental Epidemiology* 13(3): 203-210.
18. Buhler, W., R. McRackan, M. Weaver, B. Brennan, and R. Bellinger. 2002. The Southern Region Pesticide Safety Education Center: A Regional Approach to Train-the-Trainer. *Journal of Pesticide Safety Education* 4: 22-36.
19. Buhler, W., Edwards, C. R., Bledsoe, L., Gray, M., Steffey, K., and C. Gerber. 1998. Areawide management of corn rootworms: turning the first corner. *Pflanzenschutzberichte (Austria)* 57(2): 69-74.
20. Gibb, T. & W. Buhler. 1998. Infectivity of *Steinernema carpocapsae* (Rhabditida: Steinernematidae) in sterilized and herbicide-treated soil. *J Entomol. Sci.* 33(2): 152-157.
21. Brust, G., R. Foster & W. Buhler. 1997. Effect of rye incorporation, planting date and soil temperature on seedcorn maggot (Diptera: Anthomyiidae) damage to muskmelon transplants. *Environ. Entomol.* 26: 1323-1326.
22. Brust, G., R. Foster & W. Buhler. 1996. Comparison of insecticide use programs for managing the striped cucumber beetle in muskmelon. *J. Econ. Entomol.* 89(4): 981-986.
23. Buhler, W. & T. Gibb. 1993. Persistence of entomopathogenic nematodes against black cutworm on bentgrass. *J. Econ. Entomol.* 87(3): 638-642.
24. Buhler, W., A. York, & R. Turco. 1992. Effect of enhanced biodegradation of carbofuran on the control of striped cucumber beetle on muskmelon. *J. Econ. Entomol.* 85: 1910-1918.

B. Research Abstracts

1. Buhler, W. 2010. Think Safety First. Southeast Vegetable and Fruit Expo 2010 Yearbook. P. 45.
2. Buhler, W., R. Gardner, J. Wilson, and C. Ramsay. 2009. Applicator awareness tool: the pesticide environmental stewardship web site. 2009 North American Pesticide Applicator Certification and Safety Education Workshop. Charleston, SC, p. 2C.
3. Barnes, J., B. Whipker, W. Buhler, and I. McCall. 2009. Flurprimidol pre-plant bulb soaks controls growth of *Lilium Lancifolium* 'Orange Tiger.' 36th Plant Growth Reg. Soc. Am. Conf., Asheville, NC, p.36.
4. Barnes, J., B. Whipker, W. Buhler, and I. McCall. 2009. Osteospermum growth control with paclobutrazol substrate drenches. 36th Plant Growth Reg. Soc. Am. Conf., Asheville, NC, p. 28.
5. Buhler, W., R. Gardner, J. Wilson, and C. Ramsay. 2009. Applicator awareness tool: the pesticide environmental stewardship web site. 2009 North American Pesticide Applicator Certification and Safety Education Workshop. Charleston, SC, p. 2C.
6. Whipker, B.E., B. Krug, I. McCall, and W. Buhler. 2008. Flurprimidol pre-plant soaks and substrate drenches control excessive plant growth. Proc. 10th International Symposium of Flower Bulbs and Herbaceous Perennials, Lisse, The Netherlands. 20-24 Apr., p. 146.

7. Whipker, B.E., I. McCall, and W. Buhler. 2008. Control of calla lily growth with flurprimidol preplant tuber soaks and substrate drenches. Proc. 10th International Symposium of Flower Bulbs and Herbaceous Perennials, Lisse, The Netherlands. 20-24 Apr., p. 147.
8. Whipker, B.E., I. McCall, B. Krug, and W. Buhler. 2008. Flurprimidol preplant tuber soaks for dahlia growth control. Proc. 10th International Symposium of Flower Bulbs and Herbaceous Perennials, Lisse, The Netherlands. 20-24 Apr., p. 148.
9. Reyes, L.M., D.C. Sanders, and W.G. Buhler. 2008. Increased bell pepper yields with slow-release fertilizer. Spotlight Summary. HortTechnology 18(3): 326.
10. Buhler, W. 2008. A Homeowner's guide to integrated pest management and pesticide safety on the Internet. XI International Congress of Integrated Pest Management, Tegucigalpa, Honduras. Oct. 8-10.
11. Carey, D, B. Whipker, I. McCall, and W. Buhler. 2008. Benzyladenine controls growth of vegetative petunia. 35th Plant Growth Reg. Soc. Am. Conf., San Francisco, CA. 35:34.
12. Carey, D, B. Whipker, I. McCall, and W. Buhler. 2008. Benzyladenine foliar sprays increase offshoots on Sempervivum and Echeveria. 35th Plant Growth Reg. Soc. Am. Conf., San Francisco, CA. 35:42.
13. Carey, D., B.E. Whipker & W. Buhler. Cytokinin-based PGRS affects growth of vegetative petunia. 2007. Proc. Southern Nursery Assoc. Res. Conf. 52nd Annu. Rpt. Atlanta, GA. p. 285.
14. Buhler, W., R. Gardner, J. Wilson, and C. Ramsay. 2007. The pesticide environmental stewardship web site: what's around the corner? 2007 North American Pesticide Applicator Certification and Safety Education Workshop. Portland, ME. Aug. 19-24. p. 155.
15. Buhler, W. 2007. Using research to design and evaluate pesticide dealer training. North American Pesticide Applicator Certification & Safety Education Workshop, Portland, ME. Aug. 19-24. p. 199.
16. Buhler, W.G. and A. Noe. 2007. Safety first/seguridad primero in pesticide use in landscaping and nursery operations. The Environmental Protection Agency's Pesticide Worker Safety and Health Conference. Oct. 2-4, Arlington, VA. CD-ROM.
17. Curwin, B.D., M.J. Hein, W. T. Sanderson, M. Nishioka, W. G. Buhler. 2004. Nicotine exposure and decontamination on tobacco harvesters' hands. International Society for Exposure Analysis Conference. Philadelphia, PA.
18. Storm, J., G. Cope, W. Buhler, and K. McGinnis. 2004. Communicating results of the Agricultural Health Study (AHS) to the agricultural community. Annual Meeting of the Agricultural Health Study National Advisory Panel. Feb. 26-27, Bethesda, MD.
19. Storm, J., G. Cope, W. Buhler, and K. McGinnis. 2004. Educating agricultural and health practitioners about the Agricultural Health Study. National Symposium on Agricultural Health and Safety, June 20-24, Keystone, CO.
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23. Edwards, C., W. Buhler, L. Bledsoe, M. Gray, and K. Steffey. 1998. The Illinois/Indiana, USA, corn rootworm areawide management program. FAO WCR/TCP Meeting.
24. Foster, R. & W. Buhler. 1997. Control of insects on bell pepper, 1996. Arthropod Mgmt. Tests Vol. 22.
25. Gibb, T., W. Buhler & C. Gerber. 1997. Black cutworm control in bentgrass, 1996. Arthropod Mgmt. Tests Vol. 22.
26. Gibb, T., W. Buhler & C. Gerber. 1997. Control of white grubs at Purdue Univ. Res. Center, 1996. Arthropod Mgmt. Tests Vol. 22.
27. Gibb, T., W. Buhler & C. Gerber. 1997. Control of white grubs with a Bt biotoxin, 1996. Arthropod Mgmt. Tests Vol. 22.
28. Buhler, W., T. Gibb & C. Gerber. 1997. Timing of insecticide applications to control white grubs, 1996. Arthropod Mgmt. Tests Vol. 22.
29. Foster, R. & W. Buhler. 1996. Control of insects on sweet corn, 1995. Arthropod Mgmt. Tests 21: 109.
30. Foster, R. & W. Buhler. 1996. Control of insects on tomato, 1995. Arthropod Mgmt. Tests 21: 181-182.
31. Foster, R. & W. Buhler. 1996. Control of insects on bell pepper, 1995. Arthropod Mgmt. Tests 21: 132.
32. Foster, R. & W. Buhler. 1996. Control of insects on collards, 1995. Arthropod Mgmt. Tests 21: 107.
33. Foster, R. & W. Buhler. 1996. Control of insects on potatoes, 1995. Arthropod Mgmt. Tests 21: 139.
34. Buhler, W. and T. Gibb. 1995. Effects of soil sterilization and an herbicide pretreatment on the virulence of *Steinernema carpocapsae*. Entomological Society of America Annual Meeting.
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37. Foster, R. & W. Buhler. 1995. Control of insects on cabbage, 1994. Arthropod Mgmt. Tests 20: 69-70.
38. Foster, R. & W. Buhler. 1995. Control of Colorado potato beetle and leafhoppers on potatoes, 1994. Arthropod Mgmt. Tests 20: 110.
39. Foster, R. & W. Buhler. 1995. Control of lepidopterous larvae in sweet corn, 1994. Arthropod Mgmt. Tests 20: 85-86.
40. Gibb, T. and W. Buhler. 1994. Turfgrass insect management. Midwest Greenscape Expo. Indianapolis, IN.
41. Buhler, W. and T. Gibb. 1994. New control techniques for urban yellow jackets. Entomological Society of America Annual Meeting.
42. Buhler, W., T. J. Gibb & H. B. Meyers. 1994. Spring management of white grubs in Chesterfield, IN, 1993. Insecticide & Acaricide Tests 19: 321.
43. Buhler, W., G. E. Brust & R. E. Foster. 1994. Control of cucumber beetles on cantaloupe in Vincennes, IN, 1993. Insecticide & Acaricide Tests 19: 77-78.

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45. Gibb, T. & W. Buhler. 1994. Control of masked chafer in W. Lafayette, IN, 1993. *Insecticide & Acaricide Tests* 19: 321-322.
46. Buhler, W. & T. Gibb. 1993. Efficacy of insecticides on black cutworm in bentgrass, 1992. *Insecticide & Acaricide Tests* 18:305.
47. Buhler, W. 1992. Biological control of turfgrass insect pests. Midwest Greenscape Expo. Indianapolis, IN.
48. Buhler, W. & T. Gibb. 1992. Black cutworms and their control. Purdue University Turfgrass Research Summary.
49. Buhler, W. and A. York. 1991. Biodegradation of carbofuran in soils used for muskmelon production. Entomological Society of America Annual Meeting.
50. Buhler, W. 1990. Enhanced biodegradation of carbofuran in soils used for muskmelon production in Indiana. Fifth Annual ARPE Student Paper Competition.
51. Buhler, W. 1989. Bugzappers, killer bees, and cicada stew – an entomologically aware public? Entomological Society of America/North Central Branch Meeting.
52. Wilson, M., W. Buhler, L. Bledsoe, and C. Vogelwede. 1989. Insecticide efficacy tests on alfalfa, Purdue University.
53. Wilson, M., W. Buhler, and P. Rensner. 1988. Insecticide efficacy tests on alfalfa, Purdue University.
54. Wilson, M., W. Buhler, and B. Worstell. 1987. Insecticide efficacy tests on alfalfa, Purdue University.
55. Buhler, W. & M. Wilson. 1986. Development of a sampling plan for the meadow spittlebug. Entomological Society of America Annual Meeting.
56. Buhler, W. 1986. Developing a sampling plan for the meadow spittlebug on alfalfa. Second Annual ARPE Student Paper Competition.
57. Buhler, W. & M. Wilson. 1986. A pest management sampling plan for the meadow spittlebug. Entomological Society of America/North Central Branch Meeting.
58. Wilson, M. and W. Buhler. 1986. Efficacy of insecticides in field tests for control of insects on alfalfa, Purdue University.
59. Wilson, M., M. Shaw, and W. Buhler. 1985. Insecticide efficacy tests on alfalfa, Purdue University.
60. Wilson, M., M. Shaw, R. Hageman, F. Chen, and W. Buhler. 1984. Insecticide efficacy tests on alfalfa, Purdue University.
61. Wilson, M., M. Shaw, R. Hageman, F. Chen, and W. Buhler. 1983. Insecticide efficacy tests on alfalfa, Purdue University.

C. Conference Proceedings

1. Whipker, B., W. Buhler, and I. McCall. 2011. Pot chrysanthemum growth control with flurprimidol foliar sprays. Proc. of the 37th Annual Plant Growth Regulation Soc. of America Conf. Aug. 7-12, 2010, Portland, OR. p. 116-121.
2. Carey, D, B. Whipker, I. McCall, and W. Buhler. 2008. Benzyladenine foliar sprays increase offshoots on *Sempervivum* and *Echeveria*. Proc. Southern Nursery Assoc. Res. Conf., Atlanta, GA. 53:518-520.

3. Carey, D, B. Whipker, I. McCall, and W. Buhler. 2008. Benzyladenine foliar sprays increase offshoots on *Sempervivum* and *Echeveria*. Proc. Plant Growth Reg. Soc. Am. Conf., San Francisco, CA. 35: 30.
4. Carey, D, B. Whipker, I. McCall, and W. Buhler. 2008. Benzyladenine controls growth of vegetative petunia. Proc. Plant Growth Reg. Soc. Am. Conf., San Francisco, CA. 35: 31.
5. Buhler, W., R. Gardner, J. Wilson, and C. Ramsay. 2007. The pesticide environmental stewardship web site: promoting proper pesticide use and handling. 16th International Plant Protection Congress. Oct. 15-18. Glasgow, Scotland. Vol. 2, 396-397.
6. Buhler, W.G. and A. Noe. 2007. Implementation of bilingual pesticide safety training resources for North Carolina landscaping and nursery operations. The Environmental Protection Agency's Pesticide Worker Safety and Health Conference. Oct. 2-4, Arlington, VA.
7. Buhler, W. 2007. Using research to design and evaluate pesticide dealer training. North American Pesticide Applicator Certification & Safety Education Workshop, Portland, ME. Aug. 19-24. pp. 201-205.
8. Buhler, W., R. Gardner, J. Wilson, & C. Ramsay. 2007. The pesticide environmental stewardship web site: what's around the corner? North American Pesticide Applicator Certification & Safety Education Workshop, Portland, ME. Aug. 19-24. pp.156-158.
9. Buhler, W. 2006. High visibility pesticide incidents course of the U.S. EPA Pesticide Regulatory Education Program, Asheville, NC May 21-25.
10. Buhler, W. and R. McRackan. 2005. High visibility pesticide incidents course of the U.S. EPA Pesticide Regulatory Education Program, Asheville, NC July 17-21.
11. Buhler, W. 2003. Dealer Day 2003. An educational program designed for North Carolina pesticide dealers. Coordinated by the Pesticide Safety Education Program, NC Cooperative Extension Service, and the Pesticide Section of the NCDA&CS. 189 pp.
12. Buhler, W. and R. McRackan. 2003. Pesticide registration/reregistration course of the U.S. EPA Pesticide Regulatory Education Program, Asheville, NC. April 13-17. 255 pp.
13. Buhler, W., C. R. Edwards, L. Bledsoe, M. Gray, and K. Steffey. 1998. Areawide management of corn rootworms: turning the first corner. Proceedings 1998 IL Ag. Pesticides Conf., Champaign-Urbana, IL, pp. 142-144.
14. Buhler, W., C. R. Edwards, L. Bledsoe, K. Steffey & M. Gray. 1997. Areawide management of corn rootworms: what's around the corner? Proceedings 1997 IL Ag. Pesticides Conf., Champaign-Urbana, IL. pp. 108-111.

D. Posters

1. Torres-Barragan, A., W. Buhler, and Y.J. Cardoza. 2010. Entomopathogenicity, host range and symbiotic bacterial associates of the nematode *Oscheius carolinensis*. Entomological Society of America Annual Meeting, San Diego, CA. Dec. 14.
2. Buhler, W. 2010. Updates to the Pesticide Environmental Stewardship Website. North Carolina Crop Protection School, Dec. 7.
3. Barnes, J., B. Whipker, W. Buhler, and I. McCall. 2009. Flurprimidol pre-plant bulb soaks control growth of *Lilium lancifolium* 'Orange Tiger.' Plant Growth Reg. Soc. Am. Conf., Asheville, NC. Aug. 2-6.
4. Buhler, W., R. Gardner, J. Wilson, & C. Ramsay. 2009. The Pesticide Environmental Stewardship Web Site: Promoting Proper Pesticide Use and Handling. 2009 North American Pesticide Applicator Certification and Safety Education Workshop, Charleston, SC. Aug. 11-13.

5. Buhler, W. 2009. A Homeowner's Guide to Integrated Pest Management and Pesticide Safety on the Internet. The Pesticide Stewardship Alliance Annual Meeting, NM. Feb. 23-25.
6. Buhler, W. 2008. IPM and Pesticide Safety for Homeowners. North Carolina Crop Protection School, Dec. 16.
7. Buhler, W. 2008. A Homeowner's Guide to Integrated Pest Management and Pesticide Safety on the Internet. XI International Congress of Integrated Pest Management, Tegucigalpa, Honduras. Oct. 8-10.
8. Buhler, W. 2007. Pesticide Safety in the Nursery and Landscape. North Carolina Crop Protection School, Dec. 11.
9. Buhler, W., R. Gardner, J. Wilson, & C. Ramsay. 2007. The Pesticide Environmental Stewardship Web Site: Promoting Proper Pesticide Use and Handling. North Carolina Crop Protection School, Dec. 11.
10. Buhler, W., R. Gardner, J. Wilson, & C. Ramsay. 2007. The Pesticide Environmental Stewardship Web Site: Promoting Proper Pesticide Use and Handling. 16th International Plant Protection Congress, Glasgow, Scotland. Oct. 15-18.
11. Buhler, W.G. 2006. Bilingual Training Resources for Pesticide Safety in the Nursery and Landscape. North Carolina Crop Protection School, Dec. 12.
12. Storm, J., G. Cope, W. Buhler, and K. McGinnis. 2006. Understanding the Agricultural Health Study: A Summary of the First 12 Years of a Long-Term Study of Iowa and North Carolina Pesticide Applicators and Farm Families. North Carolina Crop Protection School, Dec. 12.
13. Buhler, W., S. Gripe, and K. Richards. 2005. Pesticide Safety Education Centers: Building on Success. North American Pesticide Applicator Certification and Safety Education Workshop, Madison, WI. Aug. 15-18.
14. Storm, J., G. Cope, W. Buhler, and K. McGinnis. 2005. Understanding the Agricultural Health Study. A Summary of the First 12 Years of a Long-Term Study of Iowa and North Carolina Pesticide Applicators and Farm Families. North American Pesticide Applicator Certification and Safety Education Workshop, Madison, WI. Aug. 15-18.
15. Storm, J., G. Cope, W. Buhler, and K. McGinnis. 2005. Understanding the Agricultural Health Study. Priester Extension Health Conference. Lexington, KY. April 13.
16. Storm, J., G. Cope, W. Buhler, and K. McGinnis. 2004. Communicating Results of the Agricultural Health Study (AHS) to the Agricultural Community. Annual Meeting of the Agricultural Health Study National Advisory Panel. Feb. 26-27, Bethesda, MD.
17. Storm, J., G. Cope, W. Buhler, and K. McGinnis. 2004. Educating Agricultural and Health Practitioners About the Agricultural Health Study. National Symposium on Agricultural Health and Safety, June 20-24, Keystone, CO.
18. Buhler, W. and S. Toth. 2003. Dealer Day 2003: training for agrichemical dealers to enhance regulatory compliance, pesticide safety, and integrated pest management in North Carolina. Entomological Society of America Annual Meeting, Cincinnati, OH. Oct. 26-29.
19. Buhler, W., S. Toth, and R. McRackan. 2003. The Southern Region Pesticide Safety Education Center. National Certification and Training Workshop. Honolulu, HI. Aug. 11-14.
20. Curwin, B., M. Hein, W. Sanderson, and W. Buhler. 2002. Acephate Exposure and Decontamination on Tobacco Harvesters' Hands. International Society for Exposure Analysis Annual Meeting. Vancouver, BC, Canada. Aug. 11-15.

E. Editorial Reviews

1. Journal of Pesticide Safety Education, Editorial Board, Southern Region Representative, 2003-present.
2. Edited a series of four articles on Pesticide Applicator Recertification for the EPA's Certification Training and Assessment Group (CTAG). March 2011.
3. NC Agricultural Chemicals Manual. Chapter 1-Pesticide Use and Safety Information. 1999-present.
4. Transportation of Pesticides, Organic Pesticide Stewardship, and Integrated Pest Management modules of the Pesticide Environmental Stewardship website (pesticidestewardship.org)
5. Pairing epidemiological research results with a practical message to improve pesticide applicator's personal safety practices. Manuscript submitted to the Journal of Pesticide Safety Education. Dec. 2011.
6. NC Agricultural Research Service Project Outline: Influence of Orchard Management Systems on Tree Fruit Growth and Productivity by M. Parker and D. Ritchie, NCSU. Reviewer, May 2010.
7. 50 Ways to Treat Your Pesticide. Edited for County Agent Magazine. May 2010.
8. Groundwater protection and Pesticide Drift modules of the Pesticide Environmental Stewardship Web site (pesticidestewardship.org). 2010.
9. Challenges and opportunities in pesticide risk communication: developing fact sheets for diverse audiences. Manuscript submitted to the Journal of Pesticide Safety Education. 2010.
10. Pesticide Decontamination Station. A DVD for certified pesticide applicators produced by Washington State University Extension. May 2009.
11. Understanding the HazCom Standard for NC Agriculture, A DVD produced by the NC Dept. of Labor. Nov. 2009.
12. Pesticide Container Recycling Grants submitted to NCDA&CS. Review Panel. 2009.
13. Pesticide Recertification through Distance Education. Certification and Training Assessment Group progress report.
14. Final report of the Governor's Task Force on Preventing Agricultural Pesticide Exposure. 2008.
15. Acute Pesticide Injury and Illness in NC. 2008 Annual Report. Compiled by Sheila Higgins, RN, NC Dept. of Health and Human Services.
16. The effects of Benzyladenine on ornamental crops. MS Thesis. Dennis Carey. Horticulture Graduate Student.
17. Pesticide applicator certification tests: validation and the limits of score meaning. Manuscript submitted to the Journal of Pesticide Safety Education. Feb. 2008.
18. Pesticide Environmental Stewardship (eXtension) Web site modules: 1.) Pesticide Recordkeeping, 2.) Drift Management, and 3.) Protecting Groundwater/Surface water. Summer-winter 2007.
19. Comparative performance of air-induction and conventional nozzles on an axial fan sprayer in medium density apple orchards. McCartney, S. and J.D. Obermiller. Dept. review of manuscript submitted to HortTechnology. Aug. 2007.
20. Registration of Pest Control Products in Small Acreage/Specialty Crops at the NCSU IR-4 Field Research Center. Dept. Review of Project Outline written by R. Batts. Dept. of Horticultural Sci., NCSU. Nov. 2007.
21. Pesticide residues in house dust: assessment and interventions to improve pesticide handling practices. Manuscript submitted to the Journal of Pesticide Safety Education. April 2007.

22. An Alternative Sampling Technique and Sampling Time for Cucumber Beetles (Coleoptera: Chrysomelidae) on Muskmelon. Manuscript submitted to the Journal of Economic Entomology. Aug. 2006.
23. Weed Management Techniques for Small Fruits. Research proposal by Katie Jennings. Departmental Review of Project Outline for NCARS. April 2005.
24. Risk Communication Strategies for the Agricultural Health Study: Recommendations for an Integrated Plan. White Paper by A. Brown, S. Snedeker, and J. Storm. Jan. 2005.
25. Rural Health camp among pesticide sprayers of mango plantation and awareness program on safe use of pesticides at Malihabad, Lucknow, India-A report. Manuscript submitted to the Journal of Pesticide Safety Education. Aug. 2005.
26. Instrumentation to Document Environmental Conditions during Pesticide Applications. Manuscript submitted to the Journal of Pesticide Safety Education, June 14, 2004.
27. Weed Management Techniques for Small Fruits and Vegetables, Project Leader: David Monks, Departmental Review of Project Outline, NC Agricultural Research Service. 2003.
28. Environmental Health Risks to Farmers as a Result of Pesticide Mismanagement in Khanyounis Governorate, Gaza Strip. 2001. Manuscript submitted to the Journal of Pesticide Safety Education.

B. Grants and Contracts

- \$870,022: Total direct support from grants as Principal or Co-principal Investigator
 - \$116,340: Total in-kind support
1. USDA/EPA Pesticide Safety Education Program funding for NC Pesticide Applicator Certification Training. \$10,000. Aug. 2012. W. Buhler, Principal Investigator (total amount of grant came to my program).
 2. USDA/EPA Pesticide Safety Education Program funding for Pesticide Certification Training. \$10,000. Oct. 2011. W. Buhler, Principal Investigator (total amount of grant came to my program).
 3. Expanding content in the Pesticide Environmental Stewardship Website. \$14,000. W. Buhler. Funding Source: NSF-founded Center for IPM. 2011-2012.
 4. Expanding content in the Pesticide Environmental Stewardship Website. \$28,000. W. Buhler. Funding Source: NSF-founded Center for IPM. 2010-2011.
 5. Agricultural Aviation Calibration Workshop (Fly-in). \$40,950. D. Gardisser (Univ. of Arkansas) and W. Buhler, Co-PI. Funding Source: NCDA&CS Pesticide Environmental Trust Fund, Nov. 2008. (\$2,000 came to my program).
 6. Distance Education for Pesticide Environmental Stewardship. \$50,000 grant from the National Science Foundation's Center for Integrated Pest Management. W. Buhler, Principal Investigator. 2006. (\$32,000 came to my program).
 7. U.S. EPA Pesticide Regulatory Education Program in North Carolina: High Visibility Pesticide Incidents. \$97,000 grant from the Environmental Protection Agency, Washington, DC. W. Buhler, Principal Investigator. 2005-2006. (total amount of grant came to my program).

8. Improving Pesticide Stewardship through the Pesticide Safety Education Center. \$5,000 cooperative agreement with the Pesticide Records Branch of the USDA to support the Southern Region Pesticide Safety Education Center. W. Buhler, Principal Investigator. 2006.
9. Southern Region Pesticide Safety Education Center. \$3,000 grant for Training in Support of the Long Range Plan. NC Cooperative Extension Service. W. Buhler, PI. 2006.
10. U.S. EPA Pesticide Regulatory Education Program in North Carolina: High Visibility Pesticide Incidents. \$97,900 grant from the Environmental Protection Agency, Washington, DC. W. Buhler, Principal Investigator. 2004-2005. (total amount of grant came to my program).
11. Developing Training Materials for Structural Pest Control Operators in North Carolina. \$25,000 grant from the Structural Pest Control Division, North Carolina Department of Agriculture and Consumer Services. W. Buhler, Principal Investigator. 2005. (total amount of grant came to my program).
12. Recordkeeping Manual for North Carolina Private Pesticide Applicators. \$22,093 grant from the Pesticide Environmental Trust Fund (NCD&CS). W. Buhler, Principal Investigator. 2005. (total amount of grant came to my program).
13. Improving Pesticide Stewardship through the Pesticide Safety Education Center. \$4,000 cooperative agreement with the Pesticide Records Branch of the USDA to support the fifth year of the Southern Region Pesticide Safety Education Center. W. Buhler, Principal Investigator. 2005.
14. Translation of the Ornamentals and Turfgrass Pest Management Manual (AG-648) into Spanish (AGS-648) \$15,000 grant from the CropLife Foundation of CropLife America, Washington, DC. W. Buhler, Principal Investigator. 2004. (total amount of grant came to my program).
15. Improving pesticide stewardship through the Pesticide Safety Education Center. \$5,000 cooperative agreement with the Pesticide Records Branch of the USDA to support the fourth year of the Southern Region Pesticide Safety Education Center. W. Buhler, Principal Investigator. 2004
16. Training-the-trainer to improve pesticide stewardship through the Southern Region Pesticide Safety Education Center. \$10,000 grant from EPA Region IV. W. Buhler, Principal Investigator. 2004. (total amount of grant came to my program).
17. Mitigating pesticide risks through education and safety training: The Southern Region Pesticide Safety Education Center, Year Four. \$5,000 grant from the USDA Cooperative State Research, Education, and Extension Service. W. Buhler, Principal Investigator. 2004.
18. Understanding the Agricultural Health Study and the Farm Family Exposure Study. \$7,500 grant for Training in Support of the Long Range Plan. NC Cooperative Extension Service. J. Storm, Principal Investigator, G. Cope, W. Buhler, and R. McRackan, Co-PIs. 2004.
19. Establishing a Course in North Carolina for the Pesticide Regulatory Education Program (PREP). \$90,600 grant from the Environmental Protection Agency, Washington, DC. W. Buhler, Principal Investigator. 2002-2003. (total amount of grant came to my program).
20. Improving pesticide stewardship through the Pesticide Safety Education Center. \$15,000 cooperative agreement with the Pesticide Records Branch of the USDA to support the third year of the Southern Region Pesticide Safety Education Center. W. Buhler, Principal Investigator. 2002-2003.

21. Enhancing certification training for Structural Pest Operators in North Carolina. \$25,000 grant from the Structural Pest Control Division, North Carolina Department of Agriculture and Consumer Services. W. Buhler, Principal Investigator. 2002-2004. (total amount of grant came to my program).
22. Dealer Day 2003. \$5,000 cooperative agreement with the Pesticide Records Branch of the USDA to support pesticide dealer training in NC. W. Buhler and D. Seal, Co-Principal Investigators. 2002-2003.
23. Training-the-trainer to improve pesticide stewardship through the Southern Region Pesticide Safety Education Center. \$20,000 grant from EPA Region IV Urban Initiatives Program. W. Buhler, Principal Investigator. 2002-2003. (total amount of grant came to my program).
24. Pesticides and Human Health, Crop-specific Bilingual Education Materials for Workers and Producers of Tomatoes and Grapes. \$24,358 grant from the Pesticide Environmental Trust Fund (NCDA&CS). G. Cope, Principal Investigator, J. Storm, Co-Investigator. Collaborators: A. Allen, W. Buhler, A. Chaves, F. Louws, D. Sanders, and T. Sutton. 2002. (no funds came to my program).
25. Unrestricted gifts from the following agrochemical companies and distributors to support Dealer Day 2003: \$500 from Syngenta, \$500 from DuPont, \$500 from Royster-Clark, \$300 from Coastal Agrobusiness.
26. The Southern Region Pesticide Safety Education Center, \$99,373 grant received from the Pesticide Environmental Trust Fund (NCDA&CS) to continue the Southern Region Pesticide Safety and Education Center at NC State University (funding for second year of a two-year pilot program). W. Buhler, Principal Investigator. 2001-2002. In-kind support: \$57,170. (total amount of grant came to my program).
27. The Southern Region Pesticide Safety Education Center, \$10,000 grant received from the Environmental Protection Agency, Washington, DC. W. Buhler, Principal Investigator. 2001-2002. (total amount of grant came to my program).
28. Educating agricultural and health practitioners about the Agricultural Health Study, \$96,708 grant from the National Institute of Occupational Safety and Health. J. Storm, Principal Investigator; W. Buhler, G. Cope, and Katherine McGinnis, Co-Principal Investigators. 2001-2003. (no funds came to my program).
29. Pesticide environmental risk reduction through education and safety training, \$128,340 grant from the Pesticide Environmental Trust Fund (NCDA&CS) to create the Southern Region Pesticide Safety and Education Center at NC State University. W. Buhler, Principal Investigator. 2000-2001. In-kind support: \$59,170. (\$118,000 came to my program).
30. Support for the Southern Region Pesticide Safety Education Center. \$2,500 gift from the Louisiana Pest Control Association. 2000.

Receipts and Programmed Funds:

FY	Receipts¹ (\$)	EPA² (\$)
2010-2011	74,321	
2009-2010	80,000	36,000
2008-2009	85,628	26,396
2007-2008	100,155	26,396
2006-2007	120,067	26,680
2005-2006	117,060	27,003
2004-2005	107,634	27,003
2003-2004	100,173	24,847
2002-2003	97,056	43,362
2001-2002	79,353	42,142
2000-2001	75,538	46,111
1999-2000	70,000	42,901
Totals	999,925	368,841

¹ Pesticide safety Extension receipts provided through Pesticide School registration fees and training manual sales.

² Federal pass-through funds for Pesticide Certification Training provided by the Environmental Protection Agency.

IV. EXTENSION AND ENGAGEMENT WITH CONSTITUENCIES OUTSIDE THE UNIVERSITY

A. Accomplishments

1. Publications

a. Book chapters

1. In: *Ornamentals and Turfgrass Pest Management, A Pesticide Applicator Certification Manual for the Carolinas and Georgia*. NC Cooperative Extension Service Publication AG-648. 2004.
 - a. Buhler, W. G. and J. R. Baker. Introduction to Pest Management in Turfgrass and Ornamentals;
 - b. Buhler, W. G., Cultural Management for Turfgrasses;
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24. Year-end report for the Pesticide Environmental Stewardship Web Site. CIPM. Nov. 2007. 2 pp.

25. Progress Report on the Pesticide Environmental Stewardship Web site program. Center for Integrated Pest Management Advisory Board Annual Meeting. May 9, 2007.
26. Guidelines for the Journal of Pesticide Safety Education submission and review procedures. Chair of committee to craft this document. Jan. 2006.
27. Publication and distribution of the NC Pesticide Record Keeping Manual. Report submitted to the NC Pesticide Board. Jan. 2006.
28. AGREEA Report on statewide pesticide use and safety training. Submitted to B. Sheldon, Report Leader, NCSU CALS. March 2006.
29. 2006 NC Agricultural Chemicals Manual. Editorial Committee report submitted to Dean Wynne.
30. Executive Summary of the High Visibility Pesticide Incidents PREP Course submitted to EPA, July 2006.

h. Extension Resources Reviewed

1. Herbicide Carryover. PowerPoint presentation with script for Cooperative Extension Agents. Developed by Katie Jennings and David Monks. 2011.
2. Pesticide Decontamination, DVD developed by C. Ramsay, Washington State Univ. 2009.
3. Stewardship of Surface and Ground Water. An educational module for the Pesticide Environmental Stewardship Web site. R. Gardner, Cornell Univ. 2007.
4. Pesticide Recordkeeping. An educational module for the Pesticide Environmental Stewardship Web site. C. Ramsay, Washington State Univ. 2007.
5. Minimizing Pesticide Drift. An educational module for the Pesticide Environmental Stewardship Web site. J. Wilson, South Dakota State Univ. 2007.
6. Pesticide Exposure and Health -Top 10 Reasons to Use Personal Protective Equipment. 2006. PowerPoint slide presentation by J. Storm, Dept. of Environmental and Molecular Toxicology, NCSU.
7. Pesticide Related Illness and Health Issues. 2005. A distance education course for health care providers, K. McGinnis. East Carolina Univ.
8. Structural Pest Control, A Certification Manual for North Carolina. 2005. Robert McCrackan and Michael Waldvogel.
9. Insecticide Resistance: Causes and Actions. 2004. NC Cooperative Extension Service. Steve Toth.
10. Chemigation and Fertigation: Anti-Pollution Devices for Irrigation Systems. 2004. H. Wade, D. Seal, C.Clark, B. Wells, K. Messick and G. Grabow. NCDA&CS fact sheet.
11. Department Pesticide Management Policy for the Raleigh Parks and Recreation Department. 2004. Wayne Schindler, author.
12. Farmstead Security Planning-Protecting Family, Friends and Farm. 2003. Fred Whitford, et al., Purdue Pesticide Programs Bulletin. Purdue University, W. Lafayette, Ind.
13. Crop Biotechnology. 2002. Slide set and script. Jan Spears, NC Cooperative Extension Service.
14. Understanding Crop Diseases and Diagnostics. 2002. Slide set and script. Tom Creswell. NC Cooperative Extension Service.
15. Turf and Landscape Interactive (CD-ROM) Tutorial. 2002. Pesticide Applicator Training, University of Wisconsin Extension.

16. Controlling Damage in Pesticide Storage Facilities on the Farm. 2002. NC Cooperative Extension Service fact sheet.
17. Handling and Cleaning up Damaged Pesticide Containers at Home. 2002. NC Cooperative Extension Service fact sheet.
18. Guidelines for Diagnosing Plant Injury. 2001. Policy statement from the College of Agriculture-Agricultural Chemicals Policy Advisory Committee.
19. Calibrating a Backpack Sprayer. 2000. NC Cooperative Extension Service pocket guide. G. Roberson, author.
20. Managing Pests. 2000. NC Cooperative Extension Service fact sheet. M. Linker, author.
21. Agricultural Chemicals Policy. 2000. Policy statement from the College of Agriculture-Agricultural Chemicals Policy Advisory Committee.
22. Pesticide Guidelines for Extension Agents. 2000. Policy statement from the College of Agriculture-Agricultural Chemicals Policy Advisory Committee.
23. IPM and Pesticides. 1999. In: NC Master Gardener Manual by Erv Evans. NC Cooperative Extension Service.
24. Sprayer and Spreader Calibration. 1999. In: NC Certified Turfgrass Professional Training Manual. NC Cooperative Extension Service.
25. Landscape Safety and Pesticide Use. 1999. In: NC Certified Turfgrass Professional Training Manual. NC Cooperative Extension Service.
26. IPM Learning Objectives for the NC Certified Crop Advisor Program. 1999. M. Linker, NC State University.
27. Spray Drift Management. 1999. Slide set and script. Ernest Hewitt, NC Cooperative Extension Service.
28. Pesticides and Human Health. 1999. Slide set and script. Greg Cope and Julia Storm, NC Cooperative Extension Service.
29. NCSU HADSS: A Weed Control Decision Aid. 1999. Slide set and script. Andy Bennett, NC Cooperative Extension Service.
30. Herbicide Resistance Management. 1999. Slide set and script. Alan York, NC Cooperative Extension Service.
31. Pesticides, Water and Everything in Between. 1999. Slide set and script. Rich McLaughlin, NC Cooperative Extension Service.

2. Presentations

Eighteen to Twenty Pesticide Schools are offered annually through the NC Extension Service. In addition, these 2-day training sessions are offered at the annual meetings of the NC Turfgrass Council, NC Association of Landscapers and Nurseryman, and NC Structural Pest Control Association. Presentations on proper pesticide use are given by County Extension Agents, Dr. Buhler and other Extension Specialists. Approximately 1,300 people attend these Schools each year.

The following table shows the number of presentations given by Dr. Buhler by year at national, regional and state meetings (not including Pesticide School presentations).

Year	Nat.	Reg.	State	Total
2012 (Jan.-July)	3	2	4	
2011	3	2	11	16
2010	3	3	10	16
2009	3	3	4	10
2008	2	1	16	19
2007	8	2	13	23
2006	4	3	6	13
2005	3	5	3	11
2004	2	2	4	8
2003	3	1	8	12
2002	-	2	4	6
2001	-	3	2	5
2000	-	3	7	10
1999	-	-	5	5
1998	-	1	3	4

I have been interviewed by WRAL-TV and WRAL radio for two documentaries on agricultural pesticide use and safety.

3. Workshops hosted

a. National/Regional

1. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. Raleigh, Sept. 18-20, 2006. 55 attendees.
2. High Visibility Pesticide Incidents Course of the US EPA Pesticide Regulatory Education Program. Asheville, NC, May 21-25, 2006. 35 attendees.
3. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. Raleigh, Sept. 19-21, 2005.
4. High Visibility Pesticide Incidents Course of the US EPA Pesticide Regulatory Education Program, Asheville, NC, July 17-21, 2005.
5. Annual meeting of the USDA Southern Region Pesticide Safety Education Program. Local Arrangements Chair. Asheville, June 14-16, 2004.
6. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. Raleigh, Sept. 21-22, 2004.
7. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. Sept. 2003.
8. Pesticide Registration/Re-registration Course of the US EPA Pesticide Regulatory Education Program, Asheville, NC, April 13-17, 2003.
9. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. Oct. 2002.
10. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. March 2002.
11. Organized and moderated a session entitled “Hands-On Methods in Pesticide Safety Training”, Nat. Pesticide Certification & Training Annual Meeting, San Antonio, TX. 2001.
12. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. Oct. 2001.

13. The Southern Region Pesticide Safety Education Center. Three-day workshop focusing on hands-on methods for training pesticide applicators. March 2001.
- b. State/Campus
1. The NC Private Applicator Recertification Program 2012-2014. Five in-service training sessions for NC Extension Agents, Nov. 4, 7, 8, 10, and 22, 2011.
 2. The NC Private Applicator Recertification Program 2009-2011. Five in-service training sessions for NC Extension Agents, Nov. 14, 19, 21, Dec. 1, and 12, 2008.
 3. The NC Private Applicator Recertification Program 2006-2008. Five in-service training sessions for NC Extension Agents, Nov. 17, 21, 22, 30, and Dec. 6, 2005.
 4. Understanding the Agricultural Health Study and Farm Family Exposure Study. J. Storm, G. Cope, W. Buhler, R. McRackan. Raleigh, May 18, 2004.
 5. Dealer Day 2003, a one-day educational program for dealers of restricted-use pesticides. Workshops at five NC locations: Statesville, Fletcher, Plymouth, Smithfield, and Lumberton. (Hosted)
 6. All-Campus Pesticide Applicator Recertification Training. 2000. NC State University. (Hosted)
 7. The NC Private Applicator Recertification Program 2000-2002. Four in-service training sessions for NC Extension Agents, Greenville, Raleigh, Winston-Salem, Fletcher. 1999. (Hosted)
 8. All-Campus Pesticide Applicator Recertification Training. 1999. NC State University. (Hosted)

V. TECHNOLOGICAL AND MANAGERIAL INNOVATION

1. The Southern Region Pesticide Safety Education Center. In nearly all 50 states, Cooperative Extension Service Agents are expected to be able to instruct certified pesticide applicators on the safe, effective, and legal use of pesticides. New agents have little or no experience with this role. Seasoned agents could improve their training by incorporating new techniques to engage their audience in the subject matter. I created the Southern Region Pesticide Safety Education Center (SR-PSEC) in 2001 as a “train-the-trainer” program for Extension Agents and State Pesticide Inspectors from the 13-state USDA Southern Region. The goal was to equip agents and inspectors with the knowledge and resources necessary to be more effective and credible pesticide safety educators. Three-day workshops emphasizing “hands-on” methods for proper pesticide handling were offered at NC State University in 2001-2005. An On-line (Internet) tutorial, developed at Virginia Tech University, served as a pre-requisite for the workshop. Over 260 participants have attended the workshops. Speakers were selected from eight land-grant universities, NCDA&CS, and private industry. Workshop topics included minimizing pesticide exposure, controlling spray drift, selecting proper nozzles, comparing pesticide formulations, and calibrating equipment. A training manual consisting of 30 training exercises was provided and a Web site of electronic resources for pesticide safety education was demonstrated. The Center was initiated with two grants that I received from the NCDA&CS’ Pesticide Environmental Trust Fund. Subsequent funding came from the U.S. EPA, USDA Pesticide Records Branch, USDA-CSREES, NC Cooperative Extension Service and the Louisiana Pest Control Association.

Evaluations show that participants were very pleased with the workshops. The Agents and Inspectors are putting the hands-on techniques to use in their training and are having a great deal of success by engaging their audience in an active learning environment. Multiple presentations on SR-PSEC have been given at national meetings, and the process of creating the Center was documented in the *Journal of Pesticide Safety Education* so the experiences could be shared with other regions. From 2005-2010, the Northeastern Regional PSEC was conducted at Pennsylvania State University based on the model of the SR-PSEC.

After attending one of our workshops in 2002, the Coordinator of the EPA Pesticide Regulatory Education Program (PREP) asked me if I would consider hosting a PREP course in NC. Virtually all of the previous courses were held on the campus of UC Davis. My assistant and I hosted our first 5-day PREP course in Asheville, NC in 2003. It was attended by 35 pesticide regulators from across the country. The success of this ‘Pesticide Registration’ course was followed by two additional courses on ‘High Visibility Pesticide Incidents.’ The courses were well received by the participants and brought over \$280,000 in federal grant funds into our state economy.

In 2009, the SR-PSEC was included as one of eight nationally recognized certification and training projects in the Certification and Training Assessment Group Ten-Year Accomplishment Report. The Certification and Training Assessment Group (CTAG) includes representatives from the EPA, USDA, state lead agencies, and cooperative extension services whose mission is to develop guidelines for pesticide certification and training programs. By providing a forum for Agents and Inspectors to improve their knowledge and skills as pesticide safety educators and regulators, the SR-PSEC represents a major step in strengthening the infrastructure of pesticide certification and training programs.

2. Recordkeeping. Farmers are required by federal and state law to maintain records of all restricted-use pesticide applications. If they employ farm workers, they also must post information regarding pesticide applications at a central location. From information furnished by state pesticide inspector reports, farmer compliance with these regulations was lackluster. Many farmers were unaware of the specific requirements and some were negligent. In collaboration with the NCDA&CS-Structural Pest Control & Pesticides Division, I developed a manual that includes a description of all record-keeping requirements and 30 field forms to facilitate compliance with these requirements. In early 2000, more than 5,000 copies of the manuals were distributed at no cost to farmers attending re-certification classes. Recipient comments were overwhelmingly positive. Agents had multiple requests for the manual from farmers who had not yet received a copy, and another 15,000 copies were printed in 2001. The manual has dramatically improved the level of compliance with pesticide record-keeping requirements.

In 2002, the Chief of the federal Pesticide Records Branch asked me to adapt the NC manual for publication as the official USDA record-keeping manual. After slight modifications to remove specific state references were made, 22,000 copies of the new USDA manual were printed. Boxes of manuals were shipped to the coordinator of Extension Pesticide Safety Education Programs and the State Pesticide Regulatory Agency in each of 33 US states and Puerto Rico. Pesticide records specialists with USDA have distributed the manual at agricultural trade shows and commodity meetings throughout the nation. There are reports of entire supplies of copies brought to commodity trade shows being taken within the first hour of their display. The demand for additional record books from cooperating states resulted in the need to print an additional 25,000 copies in 2003. The response to the manual was reported in articles entitled “Recordkeeping Manuals a Huge Success!” in the June and October 2003 newsletters of the Federal Pesticide Recordkeeping Program.

The Chief of the federal Pesticide Records Branch reported to me in 2009 that “we are still printing the manuals. Last year we distributed 20,347 manuals, and in 2007, we distributed 22,390.

In collaboration with colleagues at NCDA&CS, I produced a record keeping form in 2007 that could be downloaded from the web as a PDF document. Many growers requested a fillable form, so in 2009, a new form consistent with the revised state law requirements was uploaded to the web in PDF, Excel and Rich Text formats. The form has been approved as a Cooperative Extension Service publication and the feedback from some of our progressive growers confirms that it is a valuable resource.

3. Dealer Training. In 2003, there were nearly 800 licensed pesticide dealers in North Carolina. A pesticide dealer is defined as any person who is engaged in the business of distributing, selling, or offering for sale restricted-use pesticides. Although their primary activity is commerce, dealers are considered a reliable source of information on pest management and pesticide use by their clientele. To make sure that this is true and that dealers do not depend exclusively on pesticide manufacturers for their information, dealers need to receive or have access to unbiased, science-based information in order to give pesticide users reliable information. I conducted a mail-in survey of all pesticide dealers across North Carolina in 2001. Nearly 50% of the total number of dealers (N=794) responded. Survey results indicated that dealers had only a minimal level of knowledge of the topics that the survey preparation committee deemed critical (such as storage, transportation, recordkeeping, supplemental labeling, and others).

Responses to the survey formed the basis for development of the “Dealer Day 2003” training programs offered at five regional locations in January and February. Over 150 dealers attended the event. Ten topics were presented by speakers from four state agencies and private industry. A web site developed specifically for dealers was demonstrated as a portal for information on pest identification and management with links to fact sheets and extension resources published by the NC Extension Service. These resources enabled dealers to provide their customers with current information on integrated pest management strategies for pests on the farm, around the yard, or in the home. The web site facilitated easy access to federal and state pesticide regulations that affect dealers and their clientele. Every dealer who attended the training program was given a binder containing speaker notes, agency and other contact information, a guide for assessing security of their operations against theft or terrorism, and designs for storage facilities, secondary containment and mix/load pads. The evaluations were very positive. Dealer Day was supported by grants from EPA Region IV, NC Cooperative Extension, and several agrochemical companies.

In 2007, I was invited to speak in a session on education programs for pesticide retailers at the North American Pesticide Applicator Certification and Safety Education Workshop, Portland, ME. It was a privilege to share the highlights of my Dealer Day program with a similar program conducted by my counterparts in Washington State.

4. Ornamental and Turfgrass Pesticide Certification Manual. Turfgrass and ornamental plant care professionals (e.g., landscapers, golf course managers, and park superintendents) are required to have a license with the NC Department of Agriculture if they apply pesticides. To be eligible for the license, they must first pass a written exam to demonstrate competence in using pesticides correctly. The exam for this applicator category was based on a study manual that was in need of major revision. Our neighboring states of SC and GA had a similar need.

In collaboration with 11 Extension Specialists from the University of Georgia, NC State, and Clemson Universities, I developed a 160-page manual that includes chapters on licensing requirements for each of the three states represented, and pest management techniques for insect, weed, and disease pests on turfgrass and ornamentals. The manual is entitled, *Ornamental and Turfgrass Pest Management, A Pesticide Applicator Certification Manual for the Carolinas and Georgia, AG-648*. In addition to providing descriptions and line drawings of common pests, the manual facilitates preparation for the licensing exam with learning objectives and practice questions for each chapter. The reader is directed to Cooperative Extension Service resources for further information on pest control in the lawn and landscape. The manual has been translated into Spanish and a PowerPoint presentation is available on CD. Copies of the English and Spanish versions of the manual were sent to Pesticide Education Coordinators in all 50 states soon after it was published in June, 2004.

The Ornamental and Turfgrass Pest Management manual is being used as a textbook in horticulture classes taught at Auburn and Bob Jones Universities, and two North Carolina Community

Colleges. The chapter on mixing and applying the correct amount of pesticide is used in the Florida pesticide licensing manual. New Mexico is using the manual in its entirety as recommended study material for the state licensing exam. And Extension educators from Arkansas, Louisiana, Mississippi, and Michigan have requested the use of parts of the manual in revising their respective state licensing manuals. In 2005, the manual won the Blue Ribbon Extension Communication Award presented by the Southern Region-American Society for Horticultural Science, and the 2004 Outstanding Book Award, Extension and Industry Division, from the American Society for Horticultural Science. Nearly 1,600 Ornamental and Turfgrass manuals are sold to prospective pesticide applicators in NC each year.

5. Outreach to Spanish-Speakers. I am expanding our training efforts to provide pesticide safety information for the Spanish-speaking population. As Spanish-speaking entrepreneurs establish their own businesses (especially landscaping companies), they will need pesticide certification and licensing. In the past 6-7 years, I have worked with my colleagues in the Structural Pest Control and Pesticide Division of the NCDA&CS to translate and implement training materials and programs. Two training manuals, 'North Carolina Pesticide Laws and Regulations' and 'Ornamentals and Turfgrass Pest Management' have been translated into Spanish. A pilot program to provide initial certification training in Spanish was conducted at two NC venues in 2008. I arranged for Mr. Cesar Asuaje, Regional Specialized Extension Agent, University of Florida, to make presentations on pest management and pesticide handling, and Mr. Sergio Morales, Bilingual Specialist, NCDA&CS, to speak about pesticide regulations. The training programs were attended by 50 people. Ninety percent of those surveyed after the program felt that the training helped their performance on the test. There have been abundant requests for a repeat performance of this training which I hope to organize in the near future.

As Technical Consultant for the NC Environmental Stewardship Project funded by CropLife America, I directed the production of various educational resources for Spanish-speaking pesticide handlers. These materials were presented, by invitation, at the 2007 U.S. EPA Pesticide Worker Safety and Health Conference in Arlington, VA. One of these items, A DVD entitled Pesticide Safety in the Nursery and Landscape was produced with Spanish and English sound tracks. It was approved by the U.S. EPA for pesticide handler, early-entry, and worker training under the federal Worker Protection Standard and has been placed on the national list of WPS training videos. It has attained considerable statewide and national recognition as an educational resource for English and Spanish-speaking workers in greenhouse, nursery, landscape, and field crop operations.

In the fall of 2008, I was invited to speak as a guest lecturer at Zamorano University (Escuela Agricola Panamericana) in Honduras, C.A. This arrangement was facilitated by my Department Head, Dr. Julia Kornegay, and Dr. Yasmin Cardoza, Assistant Professor of Entomology at NCSU and Zamorano graduate. I presented two lectures and a hands-on calibration exercise in 'Agrichemicos', a required course for third-year agriculture students. My lectures were given in English and were based on a 70-page Spanish-translated booklet entitled Pesticide Applicator's Handbook. The 105 students in the class seemed to enjoy the presentations, handbook, and outdoor hands-on training. The instructor, Rogelio Trabanino Young, invited me back to lecture on the same material. The handbook has been used in several hands-on calibration clinics I have conducted with the assistance of translators in NC.

Partly as a result of my participation in the Governor's Task Force on Preventing Agricultural Pesticide Exposure, the 2008 NC General Assembly approved funds (\$48,548 Recurring and \$17,841 Non-recurring) for a Bilingual Pesticide Safety Educator. It was hoped that I could hire an Extension Associate and supervise this person's work in enhancing our outreach to Spanish-speaking farm workers, commercial applicators, and other pesticide handlers. Although the state's current budget woes prevented these funds from materializing, I feel it is worthy to recognize the Legislature's

willingness to appropriate funds for outreach to Spanish-speakers through the Pesticide Safety Education Program.

6. The Pesticide Environmental Stewardship Website In 2005, I was selected by members of the National Science Foundation's Center for Integrated Pest Management (CIPM) to lead the development of a distance learning web site on pesticide stewardship. The Pesticide Environmental Stewardship website (PES) (<http://pesticidestewardship.org>) is designed to be a web portal for pesticide environmental stewardship information, educational modules, and self-assessment tools. PES is for everyone whether they apply, sell, store or dispose of pesticides, provide advice or training concerning pesticide use, or have questions about pesticide stewardship. Early in the project, I assisted with the selection of topics, prepared outlines for these topics, and recruited three regional coordinators (counterparts) from other Land Grant Institutions to help with developing the content.

The website currently includes information on pesticide recordkeeping, storage and disposal, prevention of drift and spills, container management, protection of water and non-target species, calibration, and home-owner pesticide stewardship. Additional topics are in development and planned, as well as educational modules to test the user's knowledge of information contained in these topics and self assessment tools to help users assess their current level of pesticide stewardship. The project is fully funded by the CIPM through grant money that I have received and distributed via subcontracts to the three other regional coordinators. These funds have also provided support for a part-time graduate student working under my supervision.

The website has become a valuable educational resource and will provide for distance education training opportunities for pesticide applicators throughout the country. Some content of the web site will be syndicated to eXtension, a national web repository for information on a variety of subjects administered by the USDA Cooperative Extension Service (I assist in the leadership of an eXtension Pesticide Stewardship Community of Practice). Reviewers and supporters of the web project include representatives from several professional societies, major agricultural chemical companies, and the Chief of the Worker Protection Branch, Office of Pesticide Programs, EPA. In the past 5 years, I have enjoyed making presentations on new content of the website at international, national, regional, and state meetings. The website has been endorsed by national commodity organizations, agrichemical companies, and professional certification and training groups.

VI. SERVICE TO THE UNIVERSITY AND PROFESSIONAL SOCIETIES

A. University service

1. Department

- a. Department Advisory Committee (2004 to 2005, 2007-present)
- b. Post Tenure Review Committee, Organizer and Participant (2011-present).
- c. Landscape, Facilities, and Website/Newsletter Committees (2011-present)
- d. ASHS Graduate Student Travel Grants Reviewer
- e. State Employee's Combined Campaign, Co-Chair
- f. Montgomery County Agricultural Extension Agent Interview, Dept. Representative, May 2010.
- g. Staff Recognition Committee (2003 to 2005); Chair (2004-2005)
- h. Social Committee (1998 to 2002, 2006); Chair (1999-2000)
- i. Safety Committee (2002 to present); Chair (2004-2005, 2008-2009)
- j. Search Committee for Extension Associate in Pesticide Education; Chair 2000
- k. Secondary mentor for Dr. Lucy Bradley, Assistant to Associate Prof. (2006-present)

2. College

- a. NC Agricultural Chemicals Manual Editorial Committee (1998-present); Chair (2006, 2011)
- b. Crop Protection School Planning Committee (1998 to present); Chair, 2000
- c. Pesticide Licensing and Training Reporting Committee, Team Leader (1999-present)
- d. Agricultural Chemicals Policy Advisory Committee (1998-present)
- e. Pesticide Education Advisory Committee (1999-present)
- f. Pest Management Information Program Advisory Committee (2003-present)
- g. IPM Mini-grants Review Board (2008-present)
- h. Pesticides and Human Health Fact Sheet Advisory Committee 2008

3. University

- a. Faculty Senate, CALS Representative, Grievance Panel (2004 to 2006)

B. State service

1. Natural Resources Conservation Service-State Technical Review Committee
2. Fumigant Risk Mitigation Measures Project
3. Subcommittee for Agriculture Labor Contractor Education, Chair, (2010-present).
4. Subcommittee for Pesticide Safety Training Resources (2010-present).
5. Ag Development Farmland Trust Fund Advisory Committee (Designee for Ext. Admin.)
6. Interagency Pesticide Workgroup, Office of the NC Commissioner of Agriculture, Member (2009)
7. NC Entomological Society, Treasurer (2009-2010)
8. Governor's Task Force on Preventing Agricultural Pesticide Exposure (2008)
9. OSHA compliance survey for the Turfgrass Management Industry, Technical Advisory Committee, Industrial Extension Service, NC State Univ. (2008-2009)
10. Pesticide Certification and Training Manager Selection Committee, NCDA&CS (2005)
11. Crop Protection Association of North Carolina Advisor to the Board of Directors (1999-present)
12. Pesticide Container Recycling Grants Committee, NCDA&CS (1999-present)
13. Board of Collaborators, NC Agromedicine Institute (1999 to present)
14. FQPA – Organophosphate Pesticides Evaluation Committee (2001)
15. Pesticide Dealer Survey Committee; Chair (2001- 2002)
16. Pesticide Safety Videotapes Advisory Committee (Wake Forest Univ.) (2002)

17. NC Agricultural Health Study Advisory Committee (1999-present)

C. National service

1. American Association of Pesticide Safety Educators (AAPSE)
 - a. Journal of Pesticide Safety Education, Editorial Board-Southern Rep.
 - b. Committee on Committees
2. The Pesticide Environmental Stewardship Website. National Coordinator.
3. Pesticide Program Dialogue Committee (PPDC) (EPA's Advisory Committee to Office of Pesticide Programs) (2010-2013).
4. PPDC Pollinator Protection Workgroup—Communication, Education, and Training Subcommittee. Co-Leader, 2010-present.
5. EPA's Certification and Training Assessment Group (CTAG)
6. Certification Exam and Manual Assessment Committee (NASDARF)
7. The Pesticide Environmental Stewardship Web site (eXtension), Community of Practice.
8. Certification and Training Assessment Group (EPA/USDA), Member (2009-2011)
9. Community of Practice, eXtension Web Site, Pesticide Stewardship (2008-present)
10. The Pesticide Stewardship Alliance, Board of Directors (2007-2010)
11. The Pesticide Stewardship Alliance, Editor for papers and abstracts (2010), Communications Committee (2008-2011).
12. Journal of Pesticide Safety Education, Editorial Board (2002 to present)
13. EPA Pesticide Regulatory Education Program, Pesticide High-Visibility Incident Management Course, Planning Committee (2005-2006)
14. American Association of Pesticide Safety Educators (AAPSE), Board of Directors (Southern Region Rep.), (2004 to 2006)
15. Journal of Pesticide Safety Education (AAPSE), Criteria for Manuscript Review/Submission Committee, Chair (2005 to 2006)
16. Committee on Committees (AAPSE), Member (1998 to 2000); Chair (2000-2004)
17. Arrangements Committee, So. Region Pesticide Certification & Training Mtg., Chair (2003-2004)
18. EPA Pesticide Regulatory Education Program, Pesticide Registration/Reregistration Course, Planning Committee (2003)

Administration:

1. Fulfill duties as **Assistant Department Head** by serving as “acting” Head when needed and completing the following activities:

Organize and oversee Department Post-Tenure Review Committee

Edit quarterly Department of Horticultural Science Newsletter.

Maintain communications with the NC Horticulture Council,

- Revised and organized Horticulture Council Website and E-mail listserv 2011-2012
- Coordinate meetings with the Green Industry Council and representatives of the NC Horticulture Council, Fall 2011, Spring 2012.
- Organized presentation for Introduction and Accomplishments of the Horticulture Council 2012 Annual Meeting. Feb. 2012.

Oversee Kilgore Hall facilities operations and attend Building Liaison Briefing meetings.

Report on compliance with annual Fire Marshall inspection of Kilgore Hall.

Planned End-of-Semester Picnic for Departmental faculty, staff, and students, Spring 2012.

2. Fulfill duties as the **Assistant to State Program Leader in Agriculture and Natural Resources** (Dr. Tom Melton, Cooperative Extension Service Administration) by participating in, and reporting on, the following national, regional and statewide programs and committees:

National: National Program Leader's (PLN) Meeting; Organized and moderated symposium on Farmworker Health, Safety and Management, Ft Worth, TX. (Aug. 2011). Served on PLN Team for Measures for Pesticide Safety. 2011.

Member of the Agriculture Health Study National Advisory Panel, 2012.

Regional: Presentation on NC Agriculture: A national resource vital to all. Southern States Local Board Leadership Conference (Dr. Joe Zublena designee). Dec. 2010.

State: Natural Resources Conservation Service, State Technical Review Committee, Wildlife and Forestry Subcommittee, State Stewardship Committee meetings. 2011-present.

Extension Agent New Hire Orientation to Agriculture Programs. 2011-present.

NC Association of County Commissioner's Environmental Steering Committee. Designee for Dr. Joe Zublena).

NC Agriculture Development and Farmland Preservation Trust Fund (NCDA&CS)-Advisory Brd.

Co-Chair Agricultural Health Study NC Stakeholders Group.

Cvent Pilot Action Team (Sheri Schwab, Chair)

Extension Agent Evaluation and Long Range Plan Evaluation Team (Tom Melton, Chair)

International activities:

1. Invited to present two lectures and demonstrate the proper use of pesticide application equipment to a class of 105 students at the Escuela Agricola Panamericana (Zamorano University) in Honduras. Sept. 29-Oct. 8, 2008.

2. Provided funding for two Zamorano students to conduct their senior research projects on organic pesticides in Dr. Yasmin Cardoza's laboratory in the Entomology Dept, NCSU. Both students participated as interns in the Global Training Initiative Program within the CALS International Programs Office. Jan.- April 2009.

Participated in the following international meetings with poster displays and proceedings articles:

3. Buhler, W., R. Gardner, J. Wilson, and C. Ramsay. 2007. The pesticide environmental stewardship web site: promoting proper pesticide use and handling. 16th International Plant Protection Congress. Oct. 15-18. Glasgow, Scotland. Vol. 2, 396-397.

4. Buhler, W. 2008. A Homeowner's Guide to Integrated Pest Management and Pesticide Safety on the Internet. XI International Congress of Integrated Pest Management, Tegucigalpa, Honduras. Oct. 8-10.

5. Pesticide education resources that I developed and had translated into Spanish were used in a presentation given by Dr. Mike Burton in Peru. Essentials of personal pesticide safety: protecting your crop, family, environment, and health. Burton, M., R. Yupanqui-Candia, R., and W. Buhler. Quinoa,

Peru. Dec. 30, 2008.

6. Co-authored a presentation given by L.K. Bradley, NCSU: Evolution of a pesticide safety website- Cooperative Extension agents help define target audience needs. ISHS, Nanjing, China. June 27, 2011.

Professional certification and licenses:

1. Analyst-Self-Regulating Application and Flight Efficiency (Operation S.A.F.E.)-Pesticide Aerial Applicator Calibration Program
2. NC Pesticide Applicator's License-Public Operator. Categories: Ornamentals and Turfgrass and Demonstration and Research
3. Incident Command System (ICS) for Emergency Response- 100 and 200 level training, Federal Emergency Management Agency

Member, State Employees' Credit Union, Advisory Board. 2012-2014.