Title Page:

Project Title:

Establishing and Evaluating Selected Cover Crops on Small Farms to Increase the Impact of Beneficial Arthropods on Crop Pests

Project Coordinator:

Robert C. Hochmuth
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Role: Overall coordination of this project, including fiscal oversight and the responsibility for deliverable deadlines. Robert Hochmuth's current position is multi-county in nature, supporting commercial vegetable Extension programs in nine counties in the Suwannee Valley area centered around the Suwannee Valley Agricultural Extension Center (SVAEC) near Live Oak, Florida. He will manage all aspects of the project budget and approve all purchases. This will include hiring and supervising a part-time staff person. This person will be trained by the project team to collect all data regarding the arthropod populations and will be the main member of the team who will make routine visits to the farms for data collection and recordkeeping.

Institutional Administrative Contact:

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Cooperators:
(478/500 words)

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Cooperator's Role Narrative:

Farmer cooperators at Hoover Farm (Bradley Hoover Sr. and Jr.) and Rooney Farm (Scott and Billie Rooney) will host and participate in this on-farm research project. These two farms represent different cropping systems: Hoover Farm (certified organic vegetable) and Rooney Farm (sustainably managed small fruits). The farmers will advise the project team in planning and approving land use and the specific strategies to be implemented. The farmers will make land available for planting the various cover crop plots and use their equipment to prepare the land, apply fertilizers, manage weeds as needed, seed the various plantings, and provide irrigation. Cultural practices, potential pesticide applications, and other plot management protocols will be determined by the cooperators. Farmers will make available their farms for the field days and assist in presenting the research results and related information to other growers.

Dr. Leppla will serve as a technical advisor on the project, providing guidance on the experimental design and statistical analysis of the research. He also will serve as the contact person with the UF, Department of Entomology and Nematology for additional resources and expertise, such as arthropod identification and guidance on implementation of IPM practices. Dr. Leppla brings to the cover crop project a wealth of experience in conducting IPM projects and will fully participate in the data analysis and reporting phases of the project.

Elena Toro is the County Extension Agent in Suwannee County where both farms are located. She has an extensive history of working with the cooperating farmers and a working knowledge of both farms. She will assist in coordinating on-farm activities and serve as a primary contact with the farmers. Ms. Toro is an experienced Extension agent who will provide leadership in conducting the outreach aspects of the project, including the field days.

Dr. Treadwell will advise the cooperators on cultural practices for cover crops, including selection of cover crop cultivars, seeding rates, seasonal adaptations of the various crops, succession planting strategies, and plot renovation management. She is an expert in the use of cover crops on organic and sustainable farms. She has been conducting research on cover crops at the SVAEC for several years. Dr. Treadwell also is a very experienced Extension specialist, so will participate fully in the delivery of research results to farmers in the area.

Project Duration

This will be a Two Year Project.

Body of Proposal

Statement of Problem:
(484/500 words)

Sustainable agriculture in the South is increasingly practiced on small farms with limited resources by farmers who live on the farms and therefore are committed to enhancing environmental quality and conserving natural resources. This situation requires that farms be economically viable, preserve the natural resource base, and enhance the quality of life for the farmers and their families. Moreover, both large and small farms play an important role in supporting the competitiveness and sustainability of U.S. rural economies. Southern farmers continue to face many challenges, including marginal profitability and uncertain economic security. One key production challenge for farmers in the South is the cost of effectively managing the myriad of pests that infest their crops. Southern farmers must combat many insect pests, diseases, and weeds almost year-round. In particular, Florida is at risk of agricultural loss by invasive pests due to its expansive tourism industry (84 million visitors a year) and multiple ports of entry. Hurricanes have been blamed for introducing a number of economically important invasive pests into the Gulf States (Florida, Alabama, Louisiana, Mississippi, and Texas), and the region's warm and humid climate is favorable for pest establishment.

To support southern farmers' efforts to manage pests sustainably, a unique, hands-on, whole farm "Living Extension IPM Field Laboratory"(Appendix A1 and A2) has been created at the

University of Florida, Institute of Food and Agricultural Sciences (UF-IFAS), Suwannee Valley Agricultural Extension Center (SVAEC) with support from the USDA, NIFA EIPM-CS Program and the UF-IFAS Extension program ***(1, 2, 3)***. This specialized IPM learning environment is used continuously to demonstrate how to enhance agro-ecological systems for specialty crop farmers and other clientele groups by adopting a diversity of beneficial cultural and ecological practices prior to use of chemical pesticides. Thus, the IPM training program provides an infrastructure for delivering whole farm pest management practices. Small farm specialty crop producers in the region have participated in training workshops at the SVAEC and now want to implement some of the sustainable IPM practices on their farms but require assistance in selecting appropriate cover crops and monitoring their impact on pest abundance and crop yields. The practice of particular interest to the farmers is the use of cover crops to provide habitat for native beneficial arthropods but these practices have not been tested or demonstrated on small private farms in the region.

Currently, there are few effective and well-coordinated research and outreach programs designed to help southern small-holder farmers manage their pest problems. This proposal is designed specifically to help them manage pests in fruit and vegetable crops by evaluating, demonstrating and communicating the use of cover crops to create habitats for beneficial arthropods. IPM practices in this proposal will focus on increasing types and abundance of beneficial arthropods that parasitize or prey on arthropod pests. It is intended that these "first-adopters" will influence other farmers to plant cover crops to reduce the routine use of chemical insecticides.

Statement of Proposed Solution:
(479/500 words)

The solution is to transfer beneficial arthropod and cover crop research results from the SVAEC and faculty in the southeast ***(4, 5, 6, 7)*** to local cooperating private farms by demonstrating the effectiveness of annual cover crops and associated natural enemies in reducing reliance on insecticides. The 300-acre SVAEC is a showcase of best practices for ecological farm management that includes: an eight acre pond, hardwood and pine forests, softened fence line vegetation, conservation tillage agronomic and horticultural crops, cover crops, invasive plant management, a transitional organic area, protected agriculture, fruit and nut orchards, and native plant habitats for beneficial arthropods ***(8, 9, 10, 11)***. Trials at the SVAEC incorporate both annual and perennial crop habitat areas. Due to the short duration of this grant cycle, the focus of this research project will be on annual cover crops, including buckwheat, sunflowers, triticale, rye, sesame, and sunn hemp ***(12, 13, 14)***. At SVAEC the best results were obtained by planting cover crops such as rye, triticale and sunn hemp in large blocks as a rotational crop on land after the cash crop was grown. Buckwheat and sunflower, on the other hand, were grown in strips within the cash crops. Sunflower (Giganteus variety) was effective as a trap crop for stinkbugs. Buckwheat planted in strips at SVAEC was the most effective in increasing beneficial arthropods ***(15, 16)***. The research conducted at SVAEC showed the importance of making successive plantings of buckwheat throughout the year, every 30-60 days from March to November.

The project will be conducted at Hoover farm located 12 miles and Rooney farm 8 miles from SVAEC. Cooperators at both farms have participated in several trainings at SVAEC and expressed interest in implementing IPM practices on their farms. The Hoover farm utilizes cover

crops in their rotations for soil improvement, and both farms would like to include pest management in their cover crop planning. In addition, the Hoovers collaborated with some members of this team (Hochmuth, Toro, and Treadwell) on a previous On-Farm SARE project to improve their organic fertility programs ***(17)*** and are experienced with on-farm research. The planting strategy for this project will be to establish temporary cover crops and strips of cover crops within the cash crop production areas to increase beneficial arthropod populations in the cash crops.

Farmer collaborators are interested in learning how the different approaches to cover crop integration, within and adjacent to the crop production area, will influence the density and diversity of beneficial arthropods and their effect on pests, crop quality and yield. By comparing the history of insecticide use on the farms prior to cover crop integration for pest management with two years of data from this project, we anticipate a reduction in the frequency, quantity and type of insecticide applications; increased confidence and experience in cover crop use for pest management; and successful outreach to the broader farm community.

Approach and Methods:
(896/1000 words)

This on-farm research project is designed to demonstrate how to deploy cover crops on operating farms so that the species and populations of beneficial arthropods will be increased. We also will teach farmers how to increase their skill in identifying beneficial arthropods that are attracted to cover crops and how to maintain and enhance these populations on the farm year-round. This work will build upon past SARE-funded research in the South, using that information as the foundation of this proposal, incorporating knowledge on cover crops (LS02-132, LS02-140, OS10-056), beneficial insect habitat (LS04-161, GS07-057) , and agroecosystems (OS06-029, LS10-232, GS03-028) into a working system for small farms growing specialty crops. The first step will be to map both private farms so farmers can visualize existing and future habitat locations relative to production areas and other farm features. Next, research sites for the cash crops and cover crop strips on these farms will be selected by the cooperating growers.

Strip plantings of cover crops, e.g., selected annual cover crops, such as buckwheat, sunflower, rye, triticale, sesame, sunn hemp and others, will be located on both farms, but there will be an emphasis on buckwheat cover crop strips for data collection purposes. For the buckwheat cover crop strips, seeds will be planted using a seeder from the farms or a small no-till drill from SVAEC. Strips of cover crops will be established using best management practices for fertilizer, irrigation and weed management on the two farms. Trials conducted at SVAEC showed the importance of providing adequate water and fertilizer (300 lbs/A of 13-4-13) for buckwheat plots in the dry, deep, sandy soils typical of the Suwannee Valley. On the Hoover farm, plots of buckwheat and other annual cover crops will be established adjacent to or in strips within the seven acre cash crop fields to be protected, e.g., squash, cucumber, pepper, tomato, eggplant and leafy greens. On the Rooney farm, there is no idle land because blueberry and blackberry are permanent plantings; therefore, cover crops will be planted in drive rows and around the perimeter of the five acre field.

The cover crop plots will be planted beginning in summer 2014. The planting strategy will follow a schedule so that cover crop habitat is maintained year-round. This strategy is essential

to maintain beneficial arthropod populations at high levels because they need pollen and nectar sources as well as physical habitat. The cover crop plantings on these farms will provide habitat for several beneficial arthropods that parasitize or prey on pests. Based on three prior years of observations and monitoring beneficial arthropods in such plantings, the populations increase very quickly, within one year from establishing the habitat areas. Beneficial arthropods commonly found included lady beetles, a diversity of parasitic wasps, big eyed bugs, spiders, assassin bugs, minute pirate bugs, lacewing larvae, syrphid fly larvae, and many species of native pollinators. Experiences with a selection of mixed crop species will help guide the crop selections. Much is known about various crops that attract beneficial arthropods but it was unexpected to determine that sesame is incredibly attractive to many large native pollinator species, more attractive than most historically preferred plants. Sesame has a very large funnel shaped flower and abundant extrafloral nectaries making it a high value habitat crop ***(18)***. Sesame will be included in a mixed species cover crop during the warm season months to determine its attractiveness to natural enemies and pollinators on cooperating farms.

Data will be collected in three sets of buckwheat cover crop strips and adjacent cash crops as well as from three cash crop areas without buckwheat strips at each farm. Pest and beneficial arthropods will be sampled in the plots and crops weekly beginning when the plants first start to grow and support arthropods. Ten sweep net samples will be made in the center of each of three buckwheat plots, three adjacent cash crop areas, and three cash crop areas without adjacent buckwheat plantings. Each of the three experimental cash crop areas with buckwheat will be a minimum of one-half acre and each of the experimental cash crop areas without buckwheat will also be a minimum of one-half acre. The arthropods from each sample will be placed in a plastic bag and returned to SVAEC to be identified to species, if practical. Taxonomic support is available from the UF-IFAS Entomology and Nematology Department ***(19)***. Otherwise the taxonomic family will be noted or type of arthropod, e.g., spider. A representative sample of the arthropods will be preserved and retained at SVAEC. Data on the relative abundance of pest and beneficial arthropods in the plots and crop yields will be analyzed using analysis of variance (ANOVA) using JMP v.9 software ***(20)***. Additionally, the type and abundance of pest and beneficial arthropods will be compared through time to assess their rate of establishment from the beginning of the project. Cover crop development, biomass production, and ecological variables, such, rainfall, etc., also will be noted.

These farms will be demonstration sites for farmers in the region to visit. The two cooperating farmers will fully participate in the project and serve as first adopter leaders to encourage other farmers to adopt cover crops. The full project team, including both farmers, will visit both farm sites once a year to assess the progress of the research. The farmers will learn from each other and advise the team on any project improvements.

Project Relevance to Sustainable Agriculture:
(486/500 words)

The proposed on-farm research project supports several Southern SARE priorities, primarily "Beneficial Insect Habitat," "Organic Agriculture" and "Increasing Sustainability of Existing Farming Practices." It will help to make agriculture in the South more sustainable by

quantifying and delivering sustainable cover crop capabilities for enhancing beneficial arthropods primarily on small diversified farms in Florida and other southern states. Planting low maintenance annual cover crops at strategic locations in association with cash crops on farms will provide a variety of cost-effective, sustainable ecological services. Sustainability of southern farms can be increased by enhancing native populations of beneficial arthropods and increasing the ecological services provided by implementing whole farm IPM strategies ***(21, 22, 23)***.

The ongoing use of cover crops at SVAEC has transformed unsustainable pest management practices based on weekly pesticide applications to infrequent spot treatment based on scouting and pest thresholds. This remarkable conversion resulted in more than a 50% reduction in insecticide applications on the 300-acre farm over a three-year period. Not only was there a reduction in overall number of insecticide applications, but selection of low-risk pesticides protected the beneficial arthropods. Thus, the benefits of using sustainable cover crops on small farms in the Suwannee Valley have been proven but not yet delivered to local farmers.

Early adopting farmers will plant areas of cover crops and strip cover crops on their farms, resulting in reduced pesticide use and the creation of new opportunities to meet current consumer demand for agricultural products that are grown using sustainable methods. During the three past years of the USDA, NIFA-supported IPM program at the SVAEC, more than 15 education and training events and tours have been conducted each year to serve a wide range of interested audiences: small farmers, county Extension agents, NRCS field staff, Master Gardeners, UF students, the Florida A&M Small Farmer Outreach Program, 4-H Youth Day Camps in Suwannee County, and many others. Informed specialty crop farmers in the Suwannee Valley, especially beginning farmers, will readily adopt alternative IPM practices. Eventually this model can be used by communities of farmers throughout Florida and the Southeast who are seeking more sustainable farming and land management practices.

All of the beneficial arthropods collected will be identified and counted, and a representative sample will be used to build a resource collection for training farmers and others. The collection records will be documented in tables that include the species, number, date, location and crop. Results of importance to the farmers will be graphed for presentation at training events, such as field days and UF-IFAS Small Farms Academy (SFA) workshops. The IPM training through SFA will be offered in May or early June, 2015. Cooperating farmers will share their experiences as a part of these trainings. Yields will be compared between cash crops in association with cover crops and those grown conventionally on the cooperating farms. All of the results will be widely available in publications and reports, and on websites.

Timetable:
(244/250 words)

<u>Phase 1: Spring, 2014</u>

- Meet with farmers and the other cooperators, on notice of grant approval.
- Hire the part-time program assistant.
- Map the entire farms for land use and other features to identify suitable sites for cover crops.

- Select locations for cover and cash crops.
- Design and test the beneficial and pest sampling scheme.
- Collect demographic farm data to characterize the high adopting farmers from past IPM trainings.

Phase 2: Summer and Fall, 2014

- Collect baseline data on native populations of beneficial insects (before project plantings).
- Establish cover crop strips (e.g., buckwheat and sunflower) within selected cash crop plots.
- Sample and identify beneficial arthropod populations weekly.

Phase 3: Winter, Spring, and Summer, 2015

- Manage annual sequential strip cover crop plantings.
- Continue to sample and identify beneficial arthropod populations weekly.
- Determine crop yields for cover crop and non-cover crop plots.
- Analyze data and prepare tables and figures for presentation.
- Conduct field days at cooperating farms.

Phase 4: Fall and Winter, 2015

- Host a tour for local conservation agency staff, Extension agents, and early-adopter farmers.
- Continue to manage annual sequential strip cover crop plantings.
- Continue to sample and identify beneficial arthropod populations weekly.
- Analyze data and prepare tables and figures for presentation.
- Publish research results and determine program impacts.
- Place reports on websites, such as IPM Florida (http://ipm.ifas.ufl.edu/) and Florida Small Farms and Alternative Enterprises (http://smallfarms.ifas.ufl.edu/).

Outreach Plan:
(484/500 words)

For our outreach plan, demographic data will be collected to determine the characteristics of regional farmers most likely to adopt IPM farmscaping practices on their farms. Farmers in the Suwannee Valley most interested in developing farmscaping plans will be identified by questioning attendees at related IPM programs conducted periodically at SVAEC. Characteristics of their farms will be identified, such as size, topography, crop mix grown for specific markets, plant phenologies, pest and natural enemy profiles, current IPM practices, etc. Survey methods also will be used to determine the greatest challenges farmer's face in implementing whole-farm IPM plans. These challenges may include operating costs, key pests, cropping systems, and availability of technical services, educational opportunities, labor, time, and management expertise. Growers who have attended previous IPM programs will be informed about the on-farm research project and field days.

Project cooperators, including the farmers, will develop a curriculum package featuring cover crops to enhance beneficial arthropods that will be delivered to farmer audiences during at least one field day at each project farm. The curriculum will include written and graphic educational materials on cover crops and associated beneficial arthropods, along with a description of the on-farm research methods, materials and results. Also included will be electronic and printed lists of associated publications. The master list of publications will be used by Extension agents to adjust their training workshops to the level of experience of the farmers, beginner versus advanced. In addition to the on-farm field days, the curriculum will be delivered at hands-on workshops conducted at the Living Extension IPM Field Laboratory at SVAEC and through the UF-IFAS Small Farms Academy, a high level, hands-on education and training program. The UF-IFAS Small Farms and Alternative Enterprises web site (http://smallfarms.ifas.ufl.edu) will host a page within the IPM page with information regarding this project and all outreach efforts will be posted on this 3 million hit site, managed by R. Hochmuth. The project information will also be posted on IPM Florida (http://ipm.ifas.ufl.edu/), managed by N. Leppla.

Additional outreach deliverables will include articles developed at least twice during the project for distribution via county Extension agents, local newspapers, and partners such as NRCS, Farm Bureau, Suwannee River Partnership, and Florida Organic Growers. At the conclusion of the project, an audiovisual presentation and hands-on workshop will be conducted, as well as an educational poster created and displayed at the Florida Small Farms and Alternative Enterprises Conference where about 700 attendees gather each year to learn about sustainable practices on small farms. The co-chairs of this flagship Florida Land Grant Institution conference are R. Hochmuth and D. Treadwell, both members of this grant team. The educational poster will be displayed at other venues as well, such as the Florida State Horticultural Society Annual Meeting, Southern Sustainable Agriculture Working Group (SSAWG), Extension Professionals Association of Florida Annual Meeting, and the National Association of County Agricultural Agents Annual Meeting and Professional Improvement Conference.

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Budget and Budget Narrative:

Budget:

Budget Item	Expense
Personnel Services (temporary hourly labor)……..	$ 4,920
Fringe Benefits (4.6%)……...	$ 226
Materials & Supplies (Research at Hoover and Rooney Farms)	$ 6,850
Travel (Extension cooperators, temporary labor)	$ 890
Outreach (, education and training expenses)	$ 600
Indirect Costs (11.111%)	$1,498
Total…..	**$14,984**

Budget Narrative:

A. Personnel (Labor) $4,920 + $226 (fringe) = $5,146
Year 1. 205 hours X $12.00/hr = $2,460 + fringe at 4.6% = $113
Year 2. 205 hours X $12.00/hr = $2,460 + fringe at 4.6% = $113
This on-farm research project will be implemented by a group of four salaried professionals and additional support staff at the UF-IFAS SVAEC at no cost to the grant. The grant will fund a part-time hourly employee who will work 410 hours at an hourly rate of $12.00 per hour ($4,920 plus fringe benefits at $226). This employee will be expected to have experience in working with insect pest management systems and also with applied agricultural research projects. Under the general supervision of the Project Coordinator, the employee will coordinate the day to day activities of the project, such as working with farmers to install and maintain cover crops,

helping to develop rotational cover cropping systems, and sampling cover and cash crops for beneficial and pest arthropods. Additional tasks will include: ordering materials and supplies, setting up and taking down field day site components, maintaining communications with farmers and UF-IFAS cooperators, sorting and identifying arthropods in field samples, and documenting activities photographically and in preliminary reports. The estimated hours in each of the four phases (1-4) of the Timetable as described above will be as follows: 60, 150, 150, and 50 respectively.

B. Operating Materials and Supplies $6,850

Materials and supplies for research at Hoover and Rooney Farms, including planting and maintaining cover crops, will require the following, including estimated expenses for both farm sites: fertilizer and organic compost materials ($250 x 2 farms x 2 years = $1,000), cover crop seed (8 species per farm @ $75.00/species x 2 farms x 2 years = $2,400), nonpermanent micro-irrigation supplies to ensure cover crop establishment at no cost to the grower. Both farms already utilize microirrigation on income producing areas; these supplies will be used to extend their current systems to the new cover crop areas ($400 x 2 farms= $800 + replacement parts for year 2 = $150, total = $950), soft pesticides (eg. Bacillus thuringiensis, spinosad, and azadiractin) safe for beneficial arthropods ($250 x 2 farms x 2 seasons per year x 2 years = $2,000), and scouting supplies ($500) for a total supplies and materials cost of $6,850.

C. Travel $890

Travel funds will be used to support faculty and staff travel from SVAEC to the Hoover and Rooney farms for planning and implementing the project at an estimated cost of $7.00 per trip (fuel for 40 miles per round trip to both farms from SVAEC) multiplied by 70 trips ($490). Additionally, travel support will be provided for key faculty members from Gainesville or Quincy, FL to participate in specific education and training activities (10 trips x an estimated fuel expense of $40 per trip = $400). Total estimated travel costs will be $445/year x 2 = $890.

D. Outreach $600

Expenses will be for printing brochures and training materials for use at field days and other training events to promote the program ($100). In addition, outreach education and training materials will be provided to participants, such as IPM curriculum notebooks, resource books, training DVDs, ID decks, guide sheets, IPM tool kits, and hand lenses. The estimated cost per set of these materials is $60 for each participant split between this proposed grant, a registration fee and other grant-funded support. The grant support requested from SARE for each set will be $10 for 50 participants ($500).

TOTAL DIRECT = ($13,486)
INDIRECT per UF requirements at 11.111% x sum of above = $1,498

TOTAL REQUEST = (13,486 + 1,498) = $14,984