CONSERVATION INNOVATION GRANTS

Semi-annual Progress Report

Grantee Name: National Center for Appropriate Technology (NCAT)	
Project Title: Sustainable American Cotton Project: Pesticide Reduction	
Agreement Number: NRCS 68-3A75-5-177	
Project Director: Rex Dufour	
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Period Covered by Report: Jan 1, 2009-Dec 31, 2009	
Project End Date: December 31, 2009	

Summary of Project Activities, 2005-2009:

This project spanned 4 years, 2005-2009. During this time, NCAT and project collaborators have worked, on average, with 25 cotton growers each year. These growers planted roughly 1,300-1,400 acres of cotton per year. Initially, the project had activities in California, Georgia and Arizona, but the Arizona collaborator dropped out in 2008. By far, the largest collaboration was with the Sustainable Cotton Project's BASIC program (Biological Agriculture Systems in Cotton) in California, which averaged 1,200 acres of cotton each year, with 19 growers participating, except in 2009, when drought limited acreage planted to cotton. The Georgia collaborators averaged about 125 planted acres enrolled in the project per year and 3-4 growers participating.

A project goal was to reduce pesticide use on enrolled acreage by 60%. Results were mixed with respect to this goal, although participating growers clearly changed their practices to support significantly less pesticide use, particularly of "hard" chemical insecticides. Some highlights include:

- Georgia growers incorporating either milkweed (beneficial habitat) or sorghum (trap crop/habitat) were able to significantly reduce applications of "hard" pesticides by one third to two thirds, depending on the year.
- Chlorpyrifos use on the BASIC-enrolled fields in California showed a 76% reduction over the average cotton grower in the region.
- 50% of the California growers adopted the same practices for the rest of their cotton as on their BASIC field, so also reduced use of "hard" chemicals on cotton.
- At least 50% of California growers utilized BASIC methods on other crops they grew (when applicable).
- 80 to 90% of the California growers used annual beneficial habitat hedgerows (See pictures at end of report.) or strip cut adjacent alfalfa.
- 70-80% of California growers saw an increase in beneficial insect species in their cotton.
- Our collaborator in California, the Sustainable Cotton Project (SCP), developed a Fiber Footprint Calculator, which is available at: http://www.sustainablecotton.org/footprint_calculator/growers/

- Increases in beneficial insects were also observed in Georgia cotton acreage planted with beneficial insect habitat.
- 6 California growers observed Georgia cotton production practices first hand, and 1 Georgia grower visited California cotton producers.

Quantifying the pesticide reductions was not an easy task. Few states have a pesticide use monitoring system, but one is California, which has a pesticide use reporting system that is perhaps the most sophisticated in the U.S. However, we found that teasing useful data out of the California system can sometimes be problematic, and this is described in more detail in subsequent paragraphs.

Georgia has no pesticide use reporting system, and so we relied on data provided by growers about pesticide use. However, with respect to Georgia, the sample size is extremely small (2-5 farmers were enrolled annually over the 3 years of the project), and the only conclusions we can draw from the Georgia experience is that the practices described in this and previous reports do seem to work in reducing the number of applications of "hard" pesticides, although more outreach about these practices is needed to complement longer term studies to overcome the "data noise" from the extremely variable weather Georgia has experienced in the last few years (extreme drought conditions), which likely influenced the pest pressure on the cotton crop.

Table 1: Summary of Insecticide Use in Georgia Cotton Fields enrolled in CIG project, 2007-2009.

2009	**Insecticides Applied to Cotton**	**Insecticide Application Rate, lbs/acre**	**Insecticides Applied to Cotton with Habitat**	**Insecticide Application Rate, lbs/acre**	**Percent Reduction of Pesticides in Cotton with Habitat**
	Temik	**3.5**	**Temik**	**3**	
	Bidren	**.4**			
					30%
2008	**Insecticides Applied to Cotton**	**Insecticide Application Rate, lbs/acre**	**Insecticides Applied to Cotton with Habitat**	**Insecticide Application Rate, lbs/acre**	**Percent Reduction of Pesticides in Cotton with Habitat**
Producer 1	Bidrin	0	Bidrin	0	
Producer 2	Bidrin	1 lbs/acre	Bidrin	.5 lbs/acre	
Producer 3	Bidrin	.5 lbs/acre	Bidrin	0	
	Average:	.5 lbs/acre		.17 lbs/acre	67%

2007	Insecticides Applied to Cotton: Karate, Aldicarb (Temik), Dicrotophos (Bidren), Cyfluthrin (Baythroid)	Average lbs/acre Insecticides Applied to Cotton		Average lbs/acre Insecticides Applied to Cotton **with Habitat**	
		5.275		3.458	34%

Table 2. Details, Insecticide use of Georgia Growers, 2007

Active Ingredient	**Class of Pesticide, Toxicity Class**	**Grower1 Cotton-Sorghum lbs/ac**	**Grower 2 Cotton-Sorghum lbs/ac**	**Grower 3 Cotton-Sorghum lbs/ac**	**Grower 4 Control Cotton lbs/ac**	**Grower 5 Powerline Control Cotton lbs/ac**	**Grower 5 House Control Cotton lbs/ac**
(Karate)	Synthetic pyrethroid, 2, Caution or Warning					0.063	0.063
Aldicarb (Temik)	Carbamate, 1, Danger, Poison	3	3.5	3.5	3.5	5	5
Dicrotophos (Bidren)	Organophospate, 1, Danger, Poison			0.375		1	1
Cyfluthrin (Baythroid)	Pyrethroid, 1,3 Danger, Caution				0.2		
		3	3.5	3.875	3.7	6.063	6.063

Average lbs/acre Insecticides Applied to Cotton:	5.28
Average lbs/acre Insecticides Applied to Cotton with Habitat:	3.46

In California, it was both difficult and time-consuming to try to tease out the pesticide usage on the enrolled acreage and make comparisons to non-enrolled acreage. California's Pesticide Use Reporting (PUR) system is probably the most sophisticated mechanism for tracking pesticide use on a state-wide basis used in the U.S. However, calculating pesticide reduction on an individual field level is a complicated process and requires care, and a contextual knowledge of how the data was collected, at all levels of the analysis. The data is only as good as the inputs from each part of the system: to analyze properly, one must get accurate field codes and grower identification numbers; field level data at the time of application must be submitted properly by the grower to the county; and then the information must be accurately entered into county and state databases. This analysis, which was done by the SCP, clearly indicated there is room for error at all levels. In future analysis, SCP would establish metrics to help compile accurate data.

Dr. Zhang, at UC Davis, who was contracted by SCP to analyze the PUR data, has provided some possible explanations for these outcomes:

- The sample of enrolled fields was not big enough, which increased the variation of the use intensity for the enrolled field group.
- The enrolled fields could be bordered by heavy pest-infested fields, which required heavy chemical use to control the pest pressure.
- BASIC growers applied more “soft” chemicals to substitute the targeted chemicals, which increase the “use intensity” for the entire enrolled group.
- The use rate varying in a large magnitude for all the chemicals may not directly reflect the reduced use or reduced risk.

The results of the 2008 study were unusable as a reliable comparison using the county average pesticide application rates compared with BASIC grower application rates, so a different approach was needed to examine the 2008 pesticide use. SCP contracted with Greg Montez, Staff Research Associate at Kearney Ag Center, to compile the results of the 2008 PUR. Greg has extensive experience in PUR data compilation and analysis and his findings indicated SCP BASIC growers significantly reduced their use of the most toxic chemicals including chlorpyrifos, the total maximum daily load (TMDL) targeted chemical in the Lower San Joaquin River. These results are summarized in Table 1.

The average pounds of chemical applied per field were chosen as the means for comparison between BASIC growers and their conventional counterparts. It can be noted that the acreage of individual fields varies between geographical areas (some cotton growing areas are more conducive to large acreage than others), so the concept of a five-mile radius area around the BASIC participants was employed to provide a method of reducing variability of acres per field. The five-mile radius also gives a better comparison of growing conditions, as opposed to using a three-county area of the Central Valley as a data pool. This compares the BASIC growers with farms having similar soil, water and regional growing conditions and provides a more appropriate comparison.

Table 3. Comparison of 2008 pesticide use on all cotton fields managed by BASIC growers, fields enrolled in the BASIC program, and fields within a five-mile radius of the enrolled BASIC fields. Chemicals highlighted in color are targeted for elimination in the BASIC program; those in green showed reduction compared to fields within 5 miles, those in pink showed an increase compared to fields within 5 miles.

	A. Fields within 5 mi radius of enrolled BASIC fields	**B.** Fields managed by BASIC Growers	Percent Difference	**C.** Fields Enrolled in BASIC Program	Percent Difference	Percent Difference
Chemical Name	Avg. lbs of chemicals applied	Avg. lbs of chemicals applied	Between Col. A and B	Avg. lbs of chemicals applied	Between Col. A and C	Between Col. B and C
(S)-Cypermethrin	3.53	3.4	3.6	4.47	-26.57	-31.3
(S)-Metolachlor	87.94					
Acephate	105.8	49.91	52.83			
Acetamiprid	3.8	3.91	-2.74			
Aldicarb	84.62	98.42	-16.32			
Avermectin	0.36	0.56	-56.37	0.77	-113.93	-36.81
Azadirachtin	1.04					
Azoxystrobin	20.22					
Bacillus Thuringensis	1.43					
Beta-Cyfluthrin	2.55					
Bifenthrin	9.42	11.22	-19.13			
Buprofezin	36.29					
Carfentrazone-Ethyl	1.58					
Chlorpyrifos	68.11	35.01	48.6	16.35	75.99	53.29
Clethodim	8.79	6.82	22.47	4	54.45	41.25
Cyclanilide	4.06	2.67	34.25	1.3	67.89	51.17
Cyfluthrin	3.03					
Dicofol	76.18					
Dimethoate	73.28	76.46	-4.33			
Dinotefuran	9.51					
Diuron	1.62	1.35	16.89	1.3	20.26	4.06
Emamectin Benzoate	0.7					
Endothall	10.58					
Ethephon	53.74	48.52	9.72	32.86	38.86	32.28
Etoxazole	2.21	2.74	-23.83			

	A. Fields within 5 mi radius of enrolled BASIC fields	**B.** Fields managed by BASIC Growers	Percent Difference	**C.** Fields Enrolled in BASIC Program	Percent Difference	Percent Difference
Chemical Name	Avg. lbs of chemicals applied	Avg. lbs of chemicals applied	Between Col. A and B	Avg. lbs of chemicals applied	Between Col. A and C	Between Col. B and C
Fenpropathrin	11.75					
Fenpyroximate	2.29					
Flonicamid	5.23	5.97	-14.34	5.25	-0.45	12.15
Fluazifop-P-Butyl	17.89					
Flumioxazin	3.65					
Glyphosate	52.63	59.71	-13.46	8.2	84.42	86.27
Glyphosate, Diammonium Salt	49.88					
Glyphosate, Isopropylamine Salt	55.77	63	-12.96	57.76	-3.58	8.31
Glyphosate, Potassium Salt	45.34	47.11	-3.91	41.3	8.89	12.32
Imidacloprid	4.09					
Indoxacarb	7.53	9.73	-29.21	23.09	-206.59	-137.29
Lambda Cyhalothrin	3.75					
Malathion	18.4					
Mcpa, Dimethylamine Salt	76.41					
Mepiquat Chloride	1.92	2.78	-44.54	2.16	-12.37	22.26
Methomyl	20.52					
Methoxyfenozide	7.45	7.85	-5.31	2.74	63.18	65.04
Mineral Oil	206.27	47.37	77.03	47.37	77.03	0
Msma	61.23					
Naled	59.75	6.43	89.25			
Novaluron	1.57					
Oxamyl	69.54	50.49	27.4	16.48	76.31	67.36
Oxyfluorfen	14.31	13.84	3.29	12.74	10.92	7.89
Paraquat Dichloride	54.1	45.73	15.47	34.7	35.85	24.11
Pendimethalin	52.95	93.56	-76.72			

	A. Fields within 5 mi radius of enrolled BASIC fields	**B.** Fields managed by BASIC Growers	Percent Difference	**C.** Fields Enrolled in BASIC Program	Percent Difference	Percent Difference
Chemical Name	Avg. lbs of chemicals applied	Avg. lbs of chemicals applied	Between Col. A and B	Avg. lbs of chemicals applied	Between Col. A and C	Between Col. B and C
Permethrin	1.69					
Potash Soap	368.53	56.22	84.75	56.22	84.75	0
Prometryn	163.4	106.81	34.63			
Propargite	107.34	49.67	53.73	49.67	53.73	0
Pymetrozine	8.04					
Pyraflufen-Ethyl	0.2	0.2	-0.94	0.15	22.61	23.33
Pyrethrins	1.29					
Pyriproxyfen	5.42	1.3	76.06	0.54	90.07	58.54
Pyrithiobac-Sodium	2.09	2.84	-35.82			
S,S,S-Tributyl Phosphorotrithioate	80.06					
Sethoxydim	9.73					
Sodium Chlorate	225.86	244.37	-8.2			
Spinetoram	1.32					
Spiromesifen	7.73					
Sulfur	426.77	72	83.13	72	83.13	0
Thiamethoxam	2.72	3.46	-26.91	0.49	81.89	85.73
Thidiazuron	3.07	2.62	14.77	2.32	24.57	11.5
Trifluralin	40.18	22.39	44.29	16.45	59.06	26.52
Urea Dihydrogen Sulfate	137.73	161.45	-17.22	188.35	-36.75	-16.66

A) Summarize the work performed during the project period covered by this report:

The main activities for 2009, described in more detail below were:

- ✓ NCAT wrote and distributed *Sustainable Cotton Production for the Humid South* (which is attached as an appendix to this document)
- ✓ 288 acres of cotton planted with habitat in California, a dramatic decrease from 2008's totals due mostly to lack of water

✓ 100 acres of cotton planted with habitat in GeorgiaGA

Please also refer to previous project reports for detail of project activities for specific years.

California

Our collaborator in California was the Sustainable Cotton Project (SCP). Water shortages finally took their toll on the cotton acreage enrolled in SCP's BASIC program (in which beneficial insect habitat is planted in, or adjacent to, cotton). The acreage planted went from 1,282 acres in 2008 to 288 in 2009, a little over a fifth of the previous year's planting. Row crop acreage was the most expendable in the context of the water shortage, but many growers had to destroy perennial crop (mostly almonds) acreage. Some of the acreage that had been previously planted to cotton did not have any water available to it. The growers and beneficial habitat planted is provided below.

Table 4: California grower habitat acreage

First Name	Last Name	Address	City	State	Zip Code	Phone #	Habitat	Acres Enroll	Notes
Paul	Goodman (HS)	16936 South Hwy 33	Dos Palos	CA	93620	(209) 652-4362	corn, zinnas (from GA) sunflowers	32	
Doug	Goodman	16936 South Hwy 33	Dos Palos	CA	93620	(209) 652-4362	corn, zinnas (from GA) sunflowers	50	
John	Andrews	6635 Andrews	Dos Palos	CA	93620	(209) 993-0883	none	10	No extra water for habitat
Chad	Crivelli	13985 Palm	Dos Palos	CA	93620	(559) 217-3435	next to alfalfa and alfalfa on field margins	10	Organic cotton
Frank	Williams	P.O. Box 276	Firebaugh	CA	96322	(559) 908-1221	none	1	No extra water for habitat or to grow cotton
Gary	Martin	P.O. Box 549	Firebaugh	CA	93622	(559) 289-0690	sunflowers, corn, sorghum	85	
Frank	Faria	3001 E. Cardella	Firebaugh	CA	93622	(559) 269-5911	afalfa nearby	10	field surrounded by alfalfa
Joe	Rascon	17171 Nielson Ave	Kerman	CA	93630	(559)-970-1595	alfalfa nearby	90	
							Total acres:	288	

Georgia

Cotton and beneficial habitat scouting for the 2009 season: There were only two producers in the program for 2009. This year a beneficial habitat of milkweed was placed along the edge of a treated cotton field associated with a peanut field. There were 2 treated fields and 2 control fields. One treated cotton field (#1) was planted on May 5, 2009, and the control field (#1) was planted on May 7, 2009. The second treated cotton field was planted much later on June 15, 2009, and the control was planted on June 14, 2009. The stink bug pest complex, including the southern green stink bug, the brown stink bug, and the green stink bug, was the only group of insects that reached economic threshold in any of the cotton fields. Bidrin was applied to control field 1 to control stink bugs. The treated field did not need an insecticide application to manage stink bugs. In addition, parasitization of the southern green stink bug by the fly parasite, *Trichopoda pennipes*, was higher in treated field 1 than in control field 1. There are no stink bugs or other major pests impacting the late-planted cotton fields because susceptible bolls had not yet developed on plants in these fields.

Beneficial habitat: Beneficial habitats of milkweed are associated with cotton-peanut farmscapes. In the treated cotton fields, 100 potted plants of milkweed, nectar-producing flowers, were placed along the interface, or common boundary, of a cotton and peanut field to serve as a food habitat for beneficial insects and insect pollinators. The milkweed was placed in the field when cotton began flowering and remained in the field until near cut-out (final stage of cotton plant growth prior to boll opening) for the cotton. Three species of fly parasites of stink bugs were observed feeding on milkweed nectar. In addition, insect pollinators and parasites of other pests fed on the nectar of these plants. Contact information of the farmers enrolled in the project.

Grower #1
John Morgan (50 acres plus control cotton field)
P.O. Box 28
Mystic, GA 31769
229-424-2527
SS# 254-86-5360

Grower #2
Mac Paulk (50 acres plus control cotton field)
344 Hawthorn Lane
Ocilla, GA 31774
229-424-3004
SS# 253-23-1492

The amount of CIG money spent on Georgia growers up to the present time:
Cotton/beneficial habitat scouting: $31,500
Soil/tissue analyses: $1000
Total: $32,500
Total number of growers over 3 years: 3 (2006) + 3 (2007) + 3 (2008) + 2 (2009) = 11 growers
Average funds per grower over 3 years: $2,954/grower/year*

Pesticide and fertilizer inputs used by each farmer. Normal fertilizer and herbicide applications for cotton production have been made. Bidrin was applied to control field 1 on Aug. 15, 2009.

The amount of CIG money spent on California growers up to the present time:
Cotton/beneficial habitat scouting: $39,000.
Total number of growers over 4 years: 17 (2006) + 23 (2007) + 17 (2008) + 8 (2009) = 65 growers
Average funds per grower over 4 years: $600/grower/year*

* The difference between the two scouting rates reflects the difference between a commercial scouting operation (in California) which is scouting thousands of acres, vs. a research-based scouting operation (in Georgia) which is only scouting hundreds of acres. The Georgia scouting was attempting to develop scouting data that could be included in peer-reviewed journals.

B) Describe significant results, accomplishments, and lessons learned. Compare actual accomplishments to the project goals in your proposal:

See above text for results and accomplishments.

Lessons learned: Monitoring pesticide usage on a large scale is very difficult, even with a reasonably good system in place. Evaluating field-level usage would've been easier and more effective if the actual field numbers for the BASIC-enrolled fields in California, as well as accurate grower ID numbers had been available early in the project. There were many places in which either error or ambiguity could insert itself into the data.

The collaborators were a mixed bag. The Arizona collaborator clearly was not up to par to work on this project, as he was fired from county extension. The Georgia collaborator, Dr. Glynn Tillman, did a good job in getting growers to experiment with using habitat, but her list of collaborating growers was extremely small, perhaps reflecting on her ARS focus of research as opposed to extension. The Sustainable Cotton Project (SCP) was our most effective collaborator. They did an excellent job of outreach to growers, as well as inducing growers to experiment with habitat plantings in their cotton fields, and it's with these growers that perhaps the most permanent changes in production practices will occur. SCP's cotton project has received funding from the State Water Board to expand their work into alfalfa and almonds, so, despite the significant, and likely permanent reduction in cotton acreage in California, many of the growers will continue habitat plantings in some of their other crops in an effort to reduce "hard" pesticide usage.

Also, as a result of State Water Board funding in California for the Sustainable Cotton Project, as well as the fact that the Arizona collaborator dropped out, the project did not use roughly one third of the money allocated for the CIG budget.

C) Describe the work that you anticipate completing in the next six-month period:

Not applicable. Project completed.

D) Provide the following in accordance with the Environmental Quality Incentives Program (EQIP) and CIG grant agreement provisions:

1. A listing of EQIP-eligible producers involved in the project, identified by name and social security number or taxpayer identification number;

See lists of names above. We were not provided SSNs in California due to privacy concerns.

2. The dollar amount of any direct or indirect payment made to each individual producer or entity for any structural, vegetative, or management practices. Both biannual and cumulative payment amounts must be submitted.

See lists of names above, and average amounts paid for crop scouting and other services to growers.

3. A self-certification statement indicating that each individual or entity receiving a direct or indirect payment for any structural, vegetative, or management practice through this grant is in compliance with the adjusted gross income (AGI) and highly-erodible lands and wetlands conservation (HEL/WC) compliance provisions of the Farm Bill.

Since all the enrolled farmers are enrolled with NRCS conservation programs, I certify that each individual/entity receiving a direct or indirect payment through this grant is in compliance with the adjusted gross income (AGI) and highly-erodible lands and wetlands conservation (HEL/WC) compliance provisions of the Farm Bill. Signed, Rex Dufour, NCAT/California

Pictures from 2009:

Native Perennial Habitat: One California cotton grower chose to put in native perennial habitat adjacent to his cotton field. From forground: Holly Leaf Cherry, Coyote Brush, Coyote Brush, Deer grass.

Annual Habitat: This California cotton grower chose to put annual habitat adjacent to his cotton field, including sunflowers, and zinnias.

Annual Habitat: This California cotton grower planted rows of sorghum, sunflower, and corn as habitat between two cotton fields. From left, mid June 2009, mid July 2009, mid September, 2009.