BIOLOGICALLY INTEGRATED FARMING SYSTEMS (BIFS) PROGRAM

A Progress Report to the California State Legislature
on the Implementation of Assembly Bill 3383
(Chapter 1059, Statutes of 1994)

University of California
Office of the President
Division of Agriculture and Natural Resources
Statewide Special Programs and Projects
Sustainable Agriculture Research and Education Program

January 1999

The BIFS program is an integral part of the University of California Sustainable Agriculture Research and Education Program (SAREP). SAREP provides leadership and support for scientific research and education to encourage farmers, farmworkers, and consumers in California to produce, distribute, process and consume food and fiber in a manner that is economically viable, sustains natural resources and biodiversity, and enhances the quality of life in the state's diverse communities for present and future generations.

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EXECUTIVE SUMMARY

On September 28, 1994 Governor Pete Wilson signed Assembly Bill 3383 (Bornstein, Brown, and Snyder). The bill requested that the Regents of the University of California establish a pilot demonstration program to provide extension services, training, and financial incentives for farmers who voluntarily participate in pilot projects to reduce their use of agricultural chemicals. The resulting program is known as Biologically Integrated Farming Systems (BIFS). Original funds were provided from the California Department of Pesticide Regulation's Food Safety Account and the U.S. Environmental Protection Agency (US-EPA), and supported the first two pilot projects. This is the second biennial report to the legislature; the first report covered activities from January 1995 through December 1996, which included program establishment and the first year of funding of the first two projects. This report describes the implementation of the BIFS program between January 1997 and December 1998.

The University of California Sustainable Agriculture Research and Education Program (UC SAREP) administers the program. A 13-member program advisory review board continues to assist the Director of UC SAREP in developing an annual Request for Proposals (RFP) and reviews and makes recommendations for funding in accordance with AB 3383. During the first two years of the program, two projects were selected for 3 years of support, one involving wine grapes in the Lodi-Woodbridge Winegrape Commission ("Lodi-Woodbridge BIFS") and one involving cotton and row crops in the West Side of the San Joaquin Valley ("West Side BIFS"). These projects are now completing their third year and this report will cover the final two years of these two projects. In addition, two additional Requests for Proposals were released among the agricultural and research communities to identify new demonstration projects. As of January 1999, five new large-scale on-farm demonstration projects have just been started with rice in Butte County, walnuts in San Joaquin County, prunes throughout the Central Valley, citrus in Fresno County, and strawberries on the Central Coast.

The Lodi Woodbridge BIFS project started with 30 BIFS grower cooperators and 37 vineyards. By the third year of the project there are 43 BIFS growers working with 60 demonstration BIFS vineyards that total 2370 acres. These growers together manage about 50 percent (25,000 acres) of the acreage of vineyards in the Lodi-Woodbridge Winegrape Commission (LWWC). Cover crops and monitoring of pests and beneficial species, two practices noted in AB 3383 as characteristics of the desired farming systems, are used in over 70 and 100 percent of the Lodi-Woodbridge BIFS vineyards, respectively. This intensive in-season monitoring and a computer database for managing this information are particular strengths of the project. By the third year of the project the proportion of BIFS vineyards sprayed for mites or leafhoppers had declined from 54 percent in 1996 to 28 percent in 1998. The percentage of acreage treated with pre-emergence herbicides declined from 70 percent to 59 percent, and the percentage of BIFS vineyards using only contact herbicides to control under-the-vine weeds increased from 19 percent in 1996 to 39 percent in 1998. Seventy-three percent of the BIFS acreage has been converted to drip irrigation, up from 57 percent in the first year of the project. This technology change can reduce the use of nitrogen by 50 percent. In 1998, a comprehensive grower survey was sent to over 600 LWWC growers, managers and PCAs. Forty-seven percent of the survey respondents have spoken to a BIFS grower and 51 percent had talked with the Lodi-Woodbridge

BIFS staff. Ninety-four percent of the growers have read the newsletter and 65 percent had attended a BIFS neighborhood grower meeting. Sixty-six percent of the respondents reported monitoring their vineyards more frequently since 1992. The results of the survey suggest that the Lodi-Woodbridge BIFS project has had a significant impact on the entire district's implementation of biologically integrated farming practices.

By the end of the third year of the West Side BIFS project, fourteen farm managers are participating and have dedicated one or more field sites of 80 acres or more to side-by-side comparison plots of BIFS versus conventional farming practices—a total of 1,653 acres in 16 field sites. The BIFS cooperators manage a total acreage of approximately 90,000 acres in the San Joaquin Valley. The most notable success in this project is in the area of soil building. On the alternative BIFS plots, 75 percent of growers incorporated the use of cover crops or manure and compost amendments into their farming practices during the project. In Fresno County, the estimated use of these practices is only 5 percent. Three years of physical, chemical and biological data have been collected and analyzed to monitor the impacts of this biologically intensive soil management program. Increases in total soil carbon, microbial biomass carbon and nitrogen, exchangeable potassium, and organic matter were seen in the BIFS sites, as compared to the conventional sites. A soil quality index is being developed with this data that should help growers decide on specific management practices that are beneficial for their soils. In 1998, through the educational activities of the West Side BIFS project, the California vegetable and field crop industry has been introduced to the potential of conservation tillage. In the area of pest management, intensive monitoring for cotton pests and beneficial insect species has been undertaken in the last two years. By the third year, several more biologically-based integrated pest management practices have been tried on-farm such as the use of cowpea buffer strips for Lygus management and release of beneficial insect species. Overall cotton insecticide use was not significantly reduced on the BIFS demonstration acreage: in 1997, 12 versus 13 applications were made, and in 1998, 26 versus 29 applications were made, respectively, in four of the enrolled sites. For weed management, the use of the pre-emergence herbicide Treflan® at variable rates at layby in tomatoes has been adopted by 40 percent of BIFS growers, and 90 percent forgo its use completely if fields have low weed pressure. The use of this technology has been estimated to reduce the amount of Treflan® used by 40-60 percent. Treflan® is used in nearly all tomato acreage in Fresno County, and BIFS growers reduced their use of the product by 20 percent during the project. Farmer and management team participant surveys conducted in November 1998 (9 respondents) reveal that all of the respondents deemed the project successful, with over half responding "very successful" in terms of exchanging and extending information. The general knowledge of participating farmers with respect to the use of cover crops, crop residue management, and biologically integrated pest management has increased.

The BIFS program advisory review board and the UC SAREP director have reviewed 1997 annual results from both projects. Specific suggestions and requirements of continued funding were identified in 1997, specifically for the West Side BIFS project. These were communicated to the project coordinator, and steps were taken to address these issues by the project. Annual and final reports were submitted in December 1998 and will be reviewed by the program advisory review board in early 1999.

New legislatively-supported funding for the BIFS program has just been allocated through Assembly Bill 1998 (Assembly Member Helen Thomson). These funds, together with continued support from US-EPA and the University of California, will permit UC SAREP to fund additional projects in 1999. A new RFP was released in November 1998.

INTRODUCTION

On September 28, 1994 Governor Pete Wilson signed Assembly Bill 3383 (Bornstein, Brown, and Snyder). The bill requested that the Regents of the University of California establish a pilot demonstration program to provide extension services, training, and financial incentives for farmers who voluntarily participate in pilot projects to reduce their use of agricultural chemicals. Attachment 1 provides the complete text for AB 3383 as chaptered (Chapter 1059, Statutes of 1994). The goal of AB 3383 is:

"… to expand the use of integrated farming systems that have been proven to decrease the use of farm chemicals," through integration of the following elements (Section 591):

(1) Relying on biological and cultural control to protect crops from pest outbreaks.
(2) Creating on-farm habitats that harbor populations of beneficial insects and mites.
(3) Using cover crops to provide some or all of the nitrogen needed by the crop plants.
(4) Directing overall attention to soil building practices.
(5) Reducing reliance upon chemicals.

The Legislature requested that the University of California establish a program of pilot demonstration projects with the following features (Section 592 (b)):

(1) The program should consist of up to five pilot demonstration projects, each project involving a different commodity or cropping system and each located in a different county.
(2) The program should be designed to extend integrated farming systems through the proven technique of farmer-to-farmer communication, with technical support provided by farm advisors, scientists, and pest control advisers.
(3) The structure of each pilot demonstration project should be patterned, to the degree feasible, after the successful Biologically Integrated Orchard Systems (BIOS) program coordinated by the Community Alliance with Family Farmers in Merced County.
(4) Pilot demonstration projects should be selected through a competitive process that supports the goals specified in Section 591. The proposals for the projects selected should demonstrate the applicant's experience in the farming systems described in subdivision (b) of Section 591, should contain documented financial and technical support, and should provide for a breadth of private sector cost sharing.
(5) Funding for the program should consist of a combination of federal, state and private sector funds…

The bill appropriated $250,000 from the Food Safety Account to the California Department of Pesticide Regulation (DPR) for the purposes of this bill. The U.S. Environmental Protection Agency (US-EPA) Region IX provided additional funds ($420,000). These funds were sufficient to support the first two pilot projects for three years. In 1997-98, US-EPA ($529,663) and the University of California Division of Agriculture and Natural Resources ($100,000) provided additional funds. These funds, together with new funds ($1 million) through AB 1998 (Attachment 6), are enabling UC SAREP to support new BIFS projects starting in the fall of 1998 and the spring of 1999.

The program, now in its fourth year, is known as Biologically Integrated Farming Systems (BIFS), to indicate that it is distinct from yet modeled after the Biologically Integrated Orchard System (BIOS) program, in accordance with AB 3383 (Section 592.(b)(3). This report describes the implementation of the BIFS program between January 1997 and December 1998.

PROGRAM OVERVIEW

The University of California Sustainable Agriculture Research and Education Program (UC SAREP) was chosen by the UC Division of Agriculture and Natural Resources to implement AB 3383 in consultation with a program advisory review board.

PROGRAM ADVISORY REVIEW BOARD

AB 3383 outlines the appointment and role for a 13-member program advisory review board (Section 593. (a)). Members of the board were originally appointed in February 1995 by the UC Vice President of Agriculture and Natural Resources (Table 1). During the ensuing years, new members have been appointed to replace a few members that left the Board.

Table 1. Members of the program advisory review board in 1998.

Name and Affiliation	**Category Specified in AB3383, Section 593**
Steven Weinbaum, Dept. of Pomology, UC Davis	University of California
Lonnie Hendricks, Farm Advisor, Merced County	University of California
Kathy Taylor, US-EPA Region IX	Relevant Federal Agencies
Walter Bunter, USDA-Natural Resources Conservation Service	Relevant Federal Agencies
Sherman Boone	Grower
Stephen Griffin, Mission Packing	Grower
Gregory T. Nelson	Grower
John Carlon, Sacramento River Partners	Nonprofit Organization
Jill Klein, Community Alliance with Family Farmers	Nonprofit Organization
Judy Stewart-Leslie	Pest Control Advisor
Jean-Mari Peltier	Department of Pesticide Regulation
Casey Walsh Casey	Department of Food and Agriculture
Kevin Olsen, S & J Ranch	DPR Pest Management Advisory Committee

POLICIES AND PROCEDURES

AB 3383 states that pilot demonstration projects should be selected through a competitive grant process (Section 592. (b) (4)) and lists the duties expected of UC SAREP (Section 594):

> ... an appropriate program whose director, in consultation with the program advisory review board, shall perform the following duties:
>
> (a) Develop policies and procedures to guide the implementation of the pilot demonstration projects. These policies and procedures shall include, but shall not be limited to, a mechanism for monitoring and summarizing pesticide and fertilizer use for each project with an assessment of overall reductions in pesticide and fertilizer use on each project.
> (b) Develop and issue requests for proposals for the pilot demonstration projects.
> (c) Review and select the proposals to be funded.
> (d) Annually review pilot demonstration projects and determine which projects shall be renewed.

UC SAREP developed specific policies and procedures to guide the implementation of the pilot demonstration projects in consultation with the program advisory review board as part of crafting the first RFP. These policies and procedures remained in effect as described in the spring 1998 BIFS RFP (Attachment 2 and Table 2).

Table 2. Corresponding sections of AB 3383 and the UC SAREP Spring 1998 BIFS Request for Proposals for demonstration projects.

AB 3383 Section Citation	Request for Proposals Section
591. (a) - (c), 592. (a) & 592. (b)	Introduction
592. (b) (4), 594. (a), 596.	Funding
598. (a) & (b)	Use of Funds
592. (b) (3), 592. (b) (4) & 594. (a)	Criteria
594. (a), 592. (b) (3) & 592. (b) (4)	Procedure and Timeline for Application, Evaluation, and Awards
592. (b) (3)	Introduction and additional resources available through UC SAREP

ADDITIONAL FUNDING

AB 3383 provided the initial BIFS funding totaling $650,000. UC SAREP obtained additional funding through competitive and discretionary funding from the US-EPA as well as from UC DANR in order to offer support for additional projects (Table 3).

Table 3. Funds Obtained for the 1998 BIFS RFP

Source	Amount

U.S. EPA Region 9 Agriculture Initiative	220,000
U.S. EPA Pollution Prevention Initiative for States	109,663
UC Division of Agriculture and Natural Resources – special allocation	100,000
U.S. EPA Food Quality Protection Act funds	200,000
Subtotal	629,663
CA Dept. of Pesticide Regulation (2% fiscal oversight administrative costs)	-6,400
Subtotal	623,263
UC SAREP program administration	-62,326
TOTAL available to BIFS projects	$560,937

In 1998, Assembly Member Helen Thomson authored AB 1998 (see Attachment 6 for a copy of the bill) to extend and modify AB 3383. With the passage of this bill, there was an appropriation of $1 million to the CA Dept. of Pesticide Regulation for BIFS, providing UC SAREP with an additional $793,800 to fund new BIFS demonstration projects and related component research. The Community Alliance with Family Farmers, the California Farm Bureau, and the University of California, among others, supported the bill.

SELECTION OF DEMONSTRATION PROJECTS

Since the program started, UC SAREP has released four Requests for Proposals (RFP) for demonstration projects. The first RFP was released in March 1995, five proposals were received in July 1995 and the BIFS Program Advisory Review Board recommended funding the top two projects. In January 1997, a second RFP was released and only one eligible proposal was received in April 1997. After careful review of this proposal, including meeting with the principal investigator and project cooperators, the BIFS Program Advisory Review Board recommended that it not be funded because it did not meet the criteria laid out in the RFP. Therefore, no new projects were initiated through this second RFP. Then in January 1998 a third RFP was released. This RFP required a two-page pre-proposal so that the applicants could obtain some feedback on the development of their full proposal (Attachment 2). A total of 17 pre-proposals were received in March 1998 (Table 4) and then 8 full proposals in June 1998 (Table 5).

Table 4. Titles, principal investigator, and organization of pre-proposals received in response to the spring 1998 Biologically Integrated Farming Systems Request for Proposals.

1998 BIFS Pre-Proposal Title	Principal Investigator	Organization
BIFS Pre-Proposal in **Rice**	Glen Fitzgerald and Randall Mutters	UC Davis-Agronomy Dept., UCCE Butte County
Sustainable **Walnut** Alternatives Project (SWAP): Expansion of the BIOS Model to Northern San Joaquin Valley Walnut Orchards	Joseph A. Grant	UCCE San Joaquin County
Whole Farm Management for **Row Crops** in the Sacramento Valley	William Olkowski, Sean Clark, Katy Pye	BIRC, UC SAFS, Yolo RCD
Environmentally Sound **Prune** Systems	Bill Olson	UCCE-Butte
BASIS (Biological Agriculture Systems in **Strawberries**): Bio-Intensive Pest Management in the Monterey Bay Region	Sean L. Swezey	UCSC-Center for Agroecology and Sustainable Food Systems
BIFS Pre-Proposal-Hedgerows in **Row Crops**	John Anderson	Hedgerow Farms
BIFS Pre-Proposal-Trinity County **Grapes**	Sue Ellen Holmstrand	Hyampom Valley Growers Association
Biologically Integrated Farming Systems at the **Urban-Wildland** Interface in Monterey (**grapes, native grasses, vegetable crops**)	Louise Jackson	UC Davis-Dept. of Veg. Crops
Using Sustainable Agriculture to Increase the Fruit Quality of **Dates** Grown in California	Albert Keck	California Date Commission
Soil, Wildlife, and Economic Benefits of Organic **Rice** in an Agricultural Complex	Robert M. McLandress	California Waterfowl Association
Sonoma County **Lodi-Woodbridge BIFS**	Pete Opatz	Sonoma County Grape Growers Association
Almond Disease Management Software Project	James Adaskaveg	UC Riverside-Plant Pathology
Soil FAB Profiles: What Does This Mean?	Ron Alves	Modesto Junior College
BIFS Pre-Proposal-**Almonds & Olives**	Bill Kruegger	Glen County UCCE
BIFS Pre-Proposal-Worm Castings in **Table Grapes**	Chuck Leming	Sust. Development Services Inc. (SDSI)
BIFS Pre-Proposal-To Create **a Small Farm Center** in Reedley, CA	Frankie Whitman	California Clean Growers
Cal Poly Permaculture Center	Douglas Williams	Cal Poly-Bioresource & Ag. Engineering Dept.

Table 5. Principal investigator, project title, and budget requested of proposals received in response to the spring 1998 Biologically Integrated Farming Systems Request for Proposals.

Principal Investigator	Project Title	Budget Requested (for first year)
Randall Mutters, UCCE Butte County	Biologically Integrated Farming System in Rice	$100,000
Gary Obenauf, Prune Board	Proposal to Develop and Implement a Biologically Integrated Production System for Prunes	$90,000
Joseph Grant, UCCE San Joaquin County	Expansion of the Biologically Integrated Orchard Systems model to Northern San Joaquin Valley Walnut Orchards	$53,720
Mark Freeman, UCCE Fresno County	Citrus Orchard Management - Economic, Environmental, and "Knowledge Access" Considerations	$79,800
Sean Swezey, UCSC Center for Agroecology and Farming Systems	BASIS (Biological Agriculture Systems in Strawberries): Bio-intensive pest management in the Monterey Bay region	$100,000
William Olkowski, Bio-Integral Resource Center	Bio Intensive Crop Management for Processing Tomatoes and Alfalfa	$100,000
Frankie Whitman, California Clean Growers Association	Alternatives to Methyl Bromide as Soil Fumigant, Non-Chemical Alternatives to Reduce Bacterial Canker Complex and Analyzing and Testing Market Demand for Crops Which Utilize These Growing Methods	$100,000
Douglas Williams, California State University San Luis Obispo	Growing Food and Community for Healthy Bioregions	$83,956
Total Amount Requested for Year One		**$707,476**
Total Amount Requested for Three Years		**$2,100,678**

The program advisory review board reviewed all proposals and met in June 1998 to evaluate proposals. The principal investigators of the top ranking proposals were invited to answer questions (in person or by teleconference) about their proposals in a brief question and answer period during this review meeting. Upon recommendation of the program advisory review board and based on available funds ($670,000 over three years), the UC SAREP director selected two new proposals for full funding: (1) Biologically Integrated Farming System for Rice submitted by Randall Mutters, UCCE Butte County Farm Advisor, (2) Proposal to Develop and Implement a Biologically Integrated Production System for Prunes submitted by Gary Obenauf, California Prune Board project manager, and offered the first year of funding for the (3) Expansion of the

Biologically Integrated Orchard Systems Model to Northern San Joaquin Valley Walnut Orchards submitted by Joe Grant, UCCE San Joaquin County farm advisor. See Attachment 3 for a copy of a press release dated August 28, 1998 that summarizes the projects for the media.

With the passage of Assembly Bill 1998 in September 1998, additional funds were made available for the BIFS program. The BIFS program advisory review board had recommended funding two additional high quality proposals if more funding became available. In October 1998, two additional projects were offered BIFS funding; (4) Citrus Orchard Management - Economic, Environmental, and "Knowledge Access" Considerations submitted by Mark Freeman, UCCE Fresno County farm advisor, and, (5) BASIS (Biological Agriculture Systems in Strawberries): Bio-Intensive Pest Management in the Monterey Bay Region submitted by Sean Swezey of UC Santa Cruz and Carolee Bull of the USDA Agricultural Research Service, Salinas. At the same time, a second and third year of funding was offered to the walnut project in the San Joaquin valley.

The following table provides an overview of the competitive grant process for 1998:

Table 6. Overview of 1998 competitive grants process administered by UC SAREP.

Activity	**Time Period**	**AB 3383 Section Citation**
Revision, production & distribution of RFP	January – February 1998	594. (b)
Pre-proposals due to UC SAREP	March 16, 1998	
Pre-proposals reviewed by BIFS program advisory review board and comments sent to principal investigators	March – April 1998	
Proposals due to UC SAREP	May 15, 1998	594. (c)
Proposals sent to program advisory review board	May 19, 1998	594. (c)
Proposal evaluation and funding decisions made by UC SAREP and program advisory review board	June 15, 1998	594. (c)
Notification of awards	July 1998	594. (c)
UC SAREP & program advisory review board annual review of funded projects and determination of which projects shall be renewed	anticipated November 1999	594. (d)

UC SAREP STAFF SUPPORT FOR PROJECT IMPLEMENTATION

UC SAREP staff provides important support work for this high-visibility demonstration program. There is one half-time BIFS project coordinator who interfaces between the contractors and the University. This coordinator provides or facilitates natural and

social science technical support to management teams in implementation (team facilitation, group meetings, information sharing, etc.), and provides or facilitates monitoring and evaluation work (develop appropriate protocols, analyze data, etc.). The coordinator oversees the reporting process for the projects and assists with documentation and evaluation of the overall BIFS program. In addition, administrative support is provided by the UC SAREP grants manager and accounting officer and additional technical support by the Director and other staff members.

The UC SAREP project coordinator has conducted site visits, telephone and electronic mail consultations, and has reviewed and provided feedback on project materials (e.g. monitoring protocols, data sheets, meeting agendas, etc.), on project reports and newsletters, and prepared the UC SAREP reports. The coordinator presented the pollution prevention successes of the BIFS and BIOS program at a national meeting of the Society of Toxicologists and Chemists (see Attachment 5). The coordinator developed several successful grant proposals to obtain additional funding for the program, and provided technical information when requested to individuals developing legislation to extend AB 3383, i.e. AB 1998. Table 7 summarizes the activities of staff.

Table 7. Summary of UC SAREP staff support: January 1997 to December 1998[1]

Site Visits, Field Days, Project Team Meetings, and other BIFS-Related Meetings

- 1/3/97 BIFS Program Advisory Review Board meeting, BIFS project P.I.s responded to board recommendations made after reviewing their first annual reports.
- January – May 1997 Meetings and evaluation of US-EPA funded project on pesticide use analysis of BIFS and BIOS projects with Settle, Dlott, Ohmart, Feder, Gibbs.
- 3/24/97 BIFS Program Advisory Review Board grower site visit to West Side BIFS project.
- March – June 1997 Recruit and hire new UC SAREP BIFS coordinator.
- 4/24/97 BIFS Program Advisory Review Board proposal review meeting.
- 6/2/97 BIFS Program Advisory Review Board and UC SAREP staff met with West Side BIFS management team to provide further direction in the implementation of their project.
- 7/22/97 BIFS Program Advisory Review Board grower site visit to Lodi-Woodbridge BIFS project (after LWWC Summer IPM Conference)
- 7/29/97 Meeting with BIOS staff about BIFS and BIOS project evaluations.
- August – February 1998 Planning meetings of eco labeling for winegrapes conference, a piggy-back project with Lodi-Woodbridge BIFS. Also involved: CAWG, EPA, Robert Mondavi Winery.
- 10/16/97, EPA Region 9 BIFS meeting, future funding, links with FQPA and Region 9 Ag Initiative.
- Monthly meetings September 1997 – June 1998 with UCD Department of Human and Community Development and representatives from CAFF-BIOS, US-EPA, DPR, and UC SAREP to discuss sociological assessment of BIFS and BIOS program.
- January 1998, Meeting and farm tour of West Side BIFS Project Co PI to discuss various on-farm habitat plantings in Yolo and Solano Counties. Included detailed discussion of trap cropping options.
- 2/25/98, Presentation on habitat for beneficial insects, West Side BIFS, Pete Goodell, organizer, 25 attendees.
- 3/26/98, Lodi-Woodbridge Winegrape Commission, Cover Crop Field Day. Technical resource support on cover crops, 100 attendees.

[1] This table does not include a list of the numerous telephone and electronic mail consultations.

Table 7 continued,

Review and Feedback of BIFS Projects Written Materials

- Lodi-Woodbridge Lodi-Woodbridge BIFS Research/IPM Program Updates, 1997-1998
- Weekly monitoring data, Outstanding in Your Fields, for West Side BIFS Program, 1997-1998.
- West Side BIFS Annual Report, 11/1/96 to 10/30/97.
- West Side BIFS Semi-Annual Report, 11/1/97 to 6/1/98
- West Side BIFS Annual Report, 11/1/97 to 11/30/98
- Lodi-Woodbridge Lodi-Woodbridge BIFS Annual Report, 10/1/96 to 10/30/97
- Lodi-Woodbridge Lodi-Woodbridge BIFS Semi-Annual Report, 11/1/97 to 3/16/98
- Lodi-Woodbridge Lodi-Woodbridge BIFS Final Report, Preliminary Draft, 9/1/95 to 11/30/98.

Presentations on the BIFS program

- June 22-25 1997, Symposium organized entitled "Community-Based Biological Farming Systems: What Data are Good Enough?" at the Pacific Branch of the Entomological Society of America's annual meeting, San Jose, California
- 9/28/97, Presentation to non-profit organizations interested in BIFS program, Winters, CA.
- 11/5/97, Organized and moderated 5 twenty minute presentations on biologically integrated grape growing projects in California (Central Valley, Central Coast, Napa, Sonoma, Lodi-Woodbridge, Sun Maid) at the Lodi Trade show.
- 11/17/97, Poster presentation at the Annual Society of Environmental Toxicologists and Chemists (SETAC), San Francisco, CA. Broome, J.C., W.H. Settle, R.L. Bugg, M. Gibbs, and C. Ohmart 1997. Biologically Integrated Farming Systems: Approaches to Voluntary Reduction of Agricultural Chemical Use, San Francisco.
- 11/18/97, US-EPA, Invited presentation at the National Meeting of the Division of OPPTS, Panel on Agricultural Initiatives; Roles of Regions, States and Others, San Francisco.
- 2/12/98, Biologically Integrated Farming Systems: Performance and Prospects, UC Davis, Alternatives in Agriculture seminar series, Mark Van Horn organized.
- 3/18-21/98, Invited presentation "Biologically Integrated Farming Systems in California Winegrapes, Almonds, Walnuts and Row Crops" at the workshop "Searching for Common Ground in the Transition to a Sustainable Agriculture in Japan and California". Funded by the Japan Foundation. Workshop organizers M. Altieri of U.C. Berkeley and H. Kazumasa of Ehime University, Japan,
- 3/26/98, Invited presentation on the BIFS program to the Department of Pesticide Regulation's Pest Management Advisory Committee, Sacramento.
- 5/16/98, Invited presentation at a workshop in Irvine California of the National Research Council's Committee on the "Future Role of Pesticides"

Written Work Products

- Agricultural Partnerships in California, Sustainable Agriculture, 9:3:1-4, UC SAREP's newsletter (**attachment 4**).
- Preparation of UC SAREP BIFS Reports to California Department of Pesticide Regulation: Semi-annual report 1997, Annual Report 1997, Semi-Annual Report 1998, Annual Report 1998.

Additional Funding Obtained for BIFS Program

- Developed a 2 page pre-proposal to Cal-Fed for more funding for BIFS, 7/28/97
- Developed a successful US-EPA Grant Proposal to the Central Valley Agricultural Initiative "Extending Biologically Integrated Farming Systems." $195,000. 1998-2001
- Developed a successful US-EPA Pollution Prevention Incentives for States (PPIS) grant proposal for $109,663, 1998-2001.
- Developed a successful US-EPA Pesticide Environmental Stewardship Program (PESP) proposal "Extending Biologically Integrated Farming Systems (BIFS) to Field and Row Crops, $40,000, 1998-1999.
- Contributions to NSF IGERT proposal for UC Davis to obtain graduate student funding for work on alternative farming systems in Ca. BIOS/BIFS, fall of 1997, successful pre-proposal but unsuccessful in full proposal.
- Developed a successful grant proposal to US-EPA "Biologically Integrated Farming Systems: California Agricultural Partnerships to Address the Food Quality Protection Act of 1996", $200,000, 1998-2001.

ANNUAL REPORTING AND REVIEW

AB 3383 requires that the program director, in consultation with the program advisory review board, "annually review pilot demonstration projects and determine which projects shall be renewed." (Section 594. (d)). UC SAREP received a 1997 annual report in November 1997 and received a final report December 30, 1998 from the Lodi-Woodbridge Winegrape BIFS. The West Side BIFS 1997 and 1998 annual reports were submitted, and the project was granted an extension until March 30, 1999 to submit their final report. All final and annual reports are available to the public through the UC SAREP program. The projects' 1997 annual reports were mailed to the program advisory review board which met in late November 1997 with the UC SAREP Director and staff to review the status of each project, determine if the projects should receive continued funding, and make recommendations for future years. The final reports will be sent to the program advisory review board. The next annual meeting will be in the spring of 1999 when the board will review the final year of the first two projects and receive updates on the five newly funded projects. UC SAREP bases the remainder of this report on summaries from the BIFS projects' annual and final report(s) and comments and analysis from the program advisory review board and the UC SAREP Director and staff.

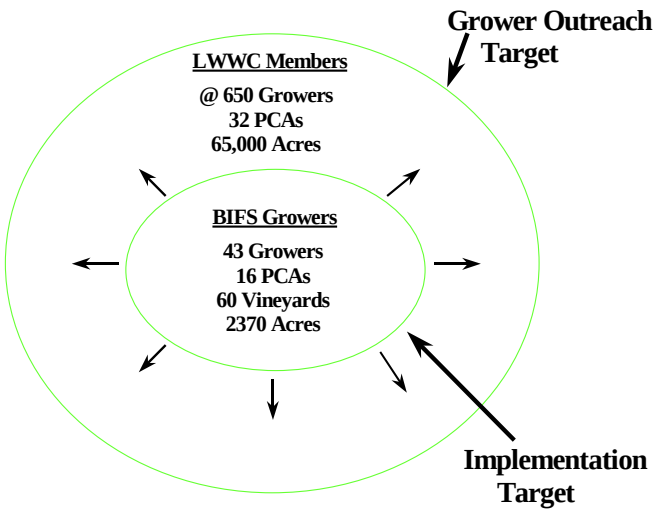
SUMMARY AND ANALYSIS OF FUNDED PROJECTS

This section provides a summary of each project using excerpts from the Final Report for the Lodi-Woodbridge BIFS project and from the West Side BIFS Final Report and Annual Reports for 1997 and 1998. In addition, evaluation is presented for each project based on the 1997 annual program advisory review board assessment and analysis of the UC SAREP Director and staff. It describes each project's outreach program, implementation of BIFS practices, related "piggyback" research projects, and then provides evaluation and documentation of the project's performance. The evaluation and documentation sub-section (as required in Section 597 of AB 3383) provides "an analysis of the monitoring activities, a summary and assessment of pesticide and fertilizer use data, and an analysis of the success of each project in meeting the standards for integrated farming systems."

LODI-WOODBRIDGE BIFS

The goal of the BIFS project in Lodi is to implement an area-wide biologically-based soil and pest management system in Crush District #11. To accomplish this goal, the project has been divided into three primary endeavors: 1) Grower outreach, 2) Implementation of practices, and 3) Monitoring and documentation. The entire Lodi-Woodbridge Winegrape Commission grower and pest control adviser (PCA) community is the target of the grower outreach project (Figure 1).

Figure 1. Graphic representation of Lodi-Woodbridge BIFS project from the Final Report, page 4.



There are approximately 650 growers who farm approximately 65,000 acres in the Lodi-Woodbridge district. During the first year of the BIFS project, 31 growers committed

demonstration acreage to the project. By the third year, a total of 43 BIFS growers are implementing many of the alternative practices on their 60 demonstration vineyards which total 2370 acres. These BIFS vineyards offer other growers in the region and elsewhere an opportunity to view these strategies being applied on a commercial scale. Sixteen Pest Control Advisors (PCAs) are also directly involved in the implementation phase of the BIFS project and through their involvement, the BIFS practices and approach is spread to an even greater number of growers who employ these PCAs.

The Lodi-Woodbridge BIFS project involves the collection and analysis of large amounts of information. Virtually all of the data for the BIFS project, from attendance at the neighborhood grower meetings to data obtained from the weekly monitoring of each vineyard, has been incorporated into a computer database. In addition to the on-going collection and analysis of information from the project, in the final year a grower survey was sent to all members of the LWWC to measure grower attitudes regarding the implementation of the BIFS/IPM project.

GROWER OUTREACH

A multi-faceted outreach approach is used in the project, which targets the three main players who influence grower practices: growers, PCAs, and winery personnel. Neighborhood grower meetings, breakfast meetings, on-farm field days and tours, workshops, as well as technical seminars are used in the outreach efforts.

Neighborhood Grower Meetings

The goal of the Neighborhood Grower Meeting (NGM) project is to sit down with every grower and PCA in the Lodi district in small groups and discuss the BIFS approach. A BIFS grower acts as "host" for these meetings and personally invites neighboring growers and PCAs to attend. The meetings last an hour or so and are set up to encourage dialogue among the growers. The UCCE viticulture farm advisor, Paul Verdegaal, attends the meetings and provides technical information and credibility. Forty NGM meetings were held from December 1995 through March 1998, attended by 406 growers, 32 PCAs, and 14 winery personnel. It is estimated that the NGM attendees are farming well over 80 percent of the district acreage. A complete outline for a NGM is presented as Appendix 1 of the Lodi-Woodbridge BIFS Final Report.

Breakfast Meetings, Workshops, Field Days, Seminars and Tours

Breakfast meetings provide another format for presenting information on specific BIFS/IPM topics to Lodi-Woodbridge Winegrape Commission members. Usually an expert in the topic area is invited to give a talk and ample time is allowed for a question and answer period. Twenty breakfast meetings were held during the 3 years of the BIFS project on topics ranging from integrated pest management for winegrapes, to soil building, to environmental laws and regulations (Table 8).

Table 8. Number of breakfast meetings and average attendance figures for each year of the BIFS project, from Table 2 of the 1998 Lodi-Woodbridge BIFS Final Report.

Year	No. Meetings	Total No. Growers	Ave. No. Growers/Mtg	Total No. PCAs	Ave. No. PCAs/Mtg	Total per Meeting Ave.
1	5	179	35.8	84	16.8	52.6
2	7	234	33.4	112	16	49.4
3	8	422	52.8	116	14.5	67.3

Workshops and field days provide a format where growers and PCAs can explore BIFS/IPM topics using a 'hands-on' approach. A field day takes place "on-site" and in a seasonally relevant timeframe for demonstrating BIFS/IPM techniques. Ten field days were conducted during the three years of the project. Some field days were particularly well attended, such as pest identification for Spanish-speaking farm workers. Other topics included use of pre-veraison water stress to improve wine quality, and spider mite and leafhopper identification. And, finally 7 half-day research seminars were organized for Lodi growers and PCAs during the three years of the BIFS project.

Newsletters

Eighteen issues of the Lodi-Woodbridge Winegrape Commission Research/IPM newsletter were sent to all Lodi-Woodbridge growers, PCAs and winery personnel during the 3 years of the BIFS project. Each newsletter usually featured an article on recent research results pertaining to IPM/BIFS topics in viticulture as well as a "grower profile" on a Lodi grower implementing BIFS strategies. Copies of the newsletter can be found in the Lodi-Woodbridge 1997 Annual Report.

IMPLEMENTATION OF PRACTICES

The grower-cooperators that have agreed to place one or more of their vineyards in the BIFS project are central to implementation of the Lodi-Woodbridge BIFS project. Also important are the PCAs who monitor these vineyards. The Lodi-Woodbridge BIFS project staff work with these two groups on implementing as many BIFS strategies as possible in the demonstration vineyards. At the end of the third year of the project, there are 43 grower-cooperators with 60 vineyards in the project. These 43 growers manage over 50 percent of the acreage of vineyards in the Lodi-Woodbridge Crush District #11 and have enrolled a total of 2370 acres in the BIFS project. Most of these growers have PCAs who monitor the fields for them. Ten BIFS grower-cooperators act as their own PCAs doing the monitoring themselves. Thirty-three of the BIFS growers have licensed PCAs helping them with their pest monitoring and providing pest management advice. There are 16 PCAs directly involved in the BIFS project. Four of them are 'in house' employees of growers, four are "independent" PCAs who charge a fee for the monitoring and advising service and do not sell any products, and eight are employees of companies which sell agrochemical products.

The implementation project began with BIFS staff sitting down with the grower-cooperator and their PCA and sketching out a 12-month farm management plan for the vineyard for the 1996 season. Vineyard management was divided into six main categories: vine nutrition; floor management between the vine rows; under-the-vine vegetation management; disease management; insect management; and mite

management. This plan was updated in 1997 and 1998 based on annual meetings. See page 11, Figure 2 in the 1998 Final report for an example of a Lodi-Woodbridge BIFS farm management plan.

All of the major winegrape varieties grown in Lodi are represented in the BIFS project, with demonstration vineyards in Zinfandel (32 percent of BIFS vineyards), Cabernet Sauvignon (20 percent), Chardonnay (18.3 percent), Merlot (15 percent), Sauvignon Blanc (5 percent), French Columbard (3.3 percent), Carignane (1.7 percent), Chenin Blanc (1.7 percent), Muscat (1.7 percent), and Syrah (1.7 percent). Table 9 lists some of the basic management practices employed and the proportion of growers using them in the 60 BIFS vineyards. The proportion of vineyards in which a particular strategy was implemented changed from 1996 to 1998 in some categories. For example, the portion of vineyards with cover crops declined from 1996 to 1998. This was due in part to the fact that quite a few of the 22 additional vineyards that joined the BIFS project after its inception did not have cover crops. This will probably change in the next few years. All of the vineyards were monitored weekly, which has a big influence on the number of vineyards sprayed for mites and leafhoppers. Seventy-two percent of the vineyards in 1998 did not spray for either pest, up from only 46 percent of vineyards that remained unsprayed in 1996. This is in spite of the fact that mite populations were higher in 1997 than they had been in previous year. Mite pressure in 1998, however, was comparable to pressure in 1996 (see 'Spider Mites' section below). The project has encouraged growers to reduce the use of pre-emergence herbicides for under-the-vine weed control. As a result, the proportion of vineyards with contact herbicide only under-the-vine weed management strategies has increased from 19 percent in 1996 to 39 percent in 1998, while the proportion of vineyards using pre-emergence herbicides declined from 70 percent in 1996 to 59 percent in 1998. Over the life of the BIFS project many growers installed drip irrigation, bringing the use of this technique in BIFS vineyards to 73 percent in 1998, up from 57 percent in 1996. This has the effect of increasing the efficiency of water use and decreasing the amount of fertilizer required by up to 50 percent.

Table 9. Biologically integrated farming practices and the percent of growers using them in Lodi-Woodbridge BIFS vineyards in 1996-1998, from Table 6 of the Lodi-Woodbridge BIFS Final Report, page 26**.**

BIFS Management Practice	% of vineyards using practice			BIFS Management Practice	% of vineyards using practice		
	1996	**1997**	**1998**		**1996**	**1997**	**1998**
Cover Crops: Annual	38%	34%	28%	Strip sprays: Pre-emergence herbicides	70%	57%	59%
Cover Crops: Perennial	53%	46%	44%	Strip sprays: Contact herbicides	19%	35%	39%
Weekly Monitoring	100%	100%	100%	Mechanical weed control under vine	10%	8%	7%
Not spraying for mites or leafhoppers	46%	50%	72%	Leaf Pulling	51%	55%	50%
Manure Addition	17%	14%	13%	Owl Boxes	-	24%	24%
Compost Addition	31%	26%	25%	Drip Irrigation	57%	60%	73%

PIGGYBACK RESEARCH

Piggyback research is designed to improve understanding and success of BIFS management and is important to the continued success of the demonstration projects. Four piggyback projects were undertaken during the 3 years of the Lodi-Woodbridge BIFS project:

- On-Farm Demonstrations of Alternatives to Methyl Bromide. This project was a collaboration with the Bio-Integral Resource Center (BIRC) and the California Department of Pesticide Regulation (DPR) to examine and test soil treatments that offer alternatives to methyl bromide use.

- PestCast Weather Station Network for Disease Management in the Lodi-Woodbridge Winegrape Commission. This project enabled the purchase of three automated weather stations that were incorporated into WEATHERNET, an automated pest phenology and weather information network in San Joaquin County, which is operated by University of California Cooperative Extension. Pestcast is a program of UC IPM, DPR, and US-EPA designed to expand the use of computer-based crop disease forecasting in California.

- Cooperation with USDA Natural Resources Conservation Service. This project was developed to demonstrate to Lodi-Woodbridge growers that the various soil building BIFS strategies are beneficial to important soil characteristics. The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil quality laboratory developed a soil testing kit that can be used in the field to “monitor” soils for effects on soil quality of various management practices.

- Eco Labeling for Winegrapes. The Lodi-Woodbridge BIFS project coordinator together with a steering committee and funding from US-EPA held an all-day conference on this topic. Leaders in this field from around the country were brought to describe their programs and afternoon interactive breakout sessions were held to encourage the development of working groups who might develop programs in their regions.

DOCUMENTATION AND EVALUATION

This section is based on summarizing the projects' own impact assessment activities and summarizing the second annual review by the program advisory review board and UC SAREP Director, as well as initial analysis by the UC SAREP Director and staff on the third annual report/final report. This section (as required in Section 597 of AB 3383) provides "an analysis of the monitoring activities, a summary and assessment of pesticide and fertilizer use data, and an analysis of the success of each project in meeting the standards for integrated farming systems." The UC SAREP BIFS request for proposals defines integrated farming systems as systems where farmers integrate the following elements into their production systems: (1) Biological and cultural control of pests; (2) On-farm habitats for beneficial insects, mites, and spiders; (3) A strong emphasis on soil-building practices, often including biological nitrogen fixation to supply all or part of the nitrogen needed by crop plants; (4) Reduced reliance on agricultural chemicals.

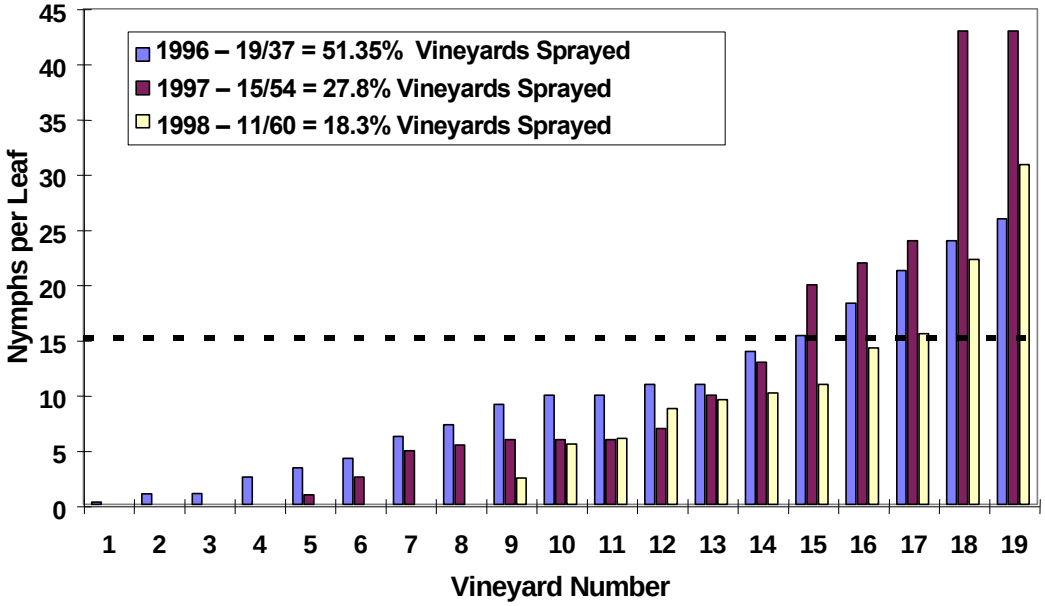
Analysis of Monitoring Activities

Each of the BIFS vineyards were monitored by BIFS staff on a weekly basis. A data sheet was left with the grower as soon as the vineyard was checked and a copy of the data sheet was faxed to the PCA at the end of the day. The variables monitored were ones that the grower and PCA would use in making pest management decisions, such as pest numbers, life stages present, and numbers of natural enemies, if present. The most important pest problems monitored in Lodi vineyards are grape leafhopper (*Erythroneura elegantula*), variegated leafhopper (*Erythroneura variabilis*), Willamette mite *(Eotetranychus willamettei*), Pacific mite (*Tetranychus pacificus*), omnivorous leafroller (*Platynota sultana*), powdery mildew (*Uncinula necator*) and bunch rot (*Botrytis cineria* and other fungi). The primary purpose of the monitoring program was to provide the Lodi-Woodbridge growers and PCAs an example of how a monitoring program might be carried out, its data interpreted and the results used in management decision-making. For details of the monitoring form and protocols see page 15, figure 3 in the Lodi-Woodbridge BIFS Final Report. Important highlights of the Lodi-Woodbridge BIFS monitoring program are discussed below.

Leafhoppers

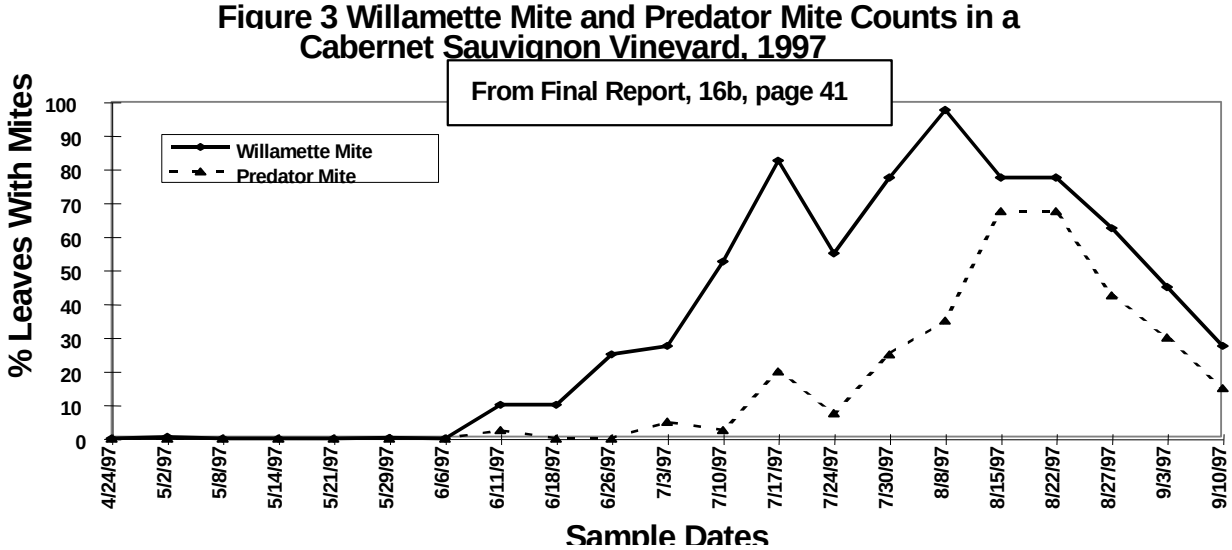
Weekly monitoring of leafhopper populations allows for growers and PCAs to be presented with up-to-date numerical or graphical summaries for each vineyard. Many scientists feel that Lodi is at the limit of distribution for variegated leafhopper and 1996 numbers reflected this; few vineyards had significant numbers of this pest. In 1996, nineteen BIFS vineyards were treated with Provado insecticide whereas in 1997, only 15 vineyards were sprayed, and in 1998 only 11 were treated (Figure 2). The Lodi-Woodbridge BIFS economic threshold for leafhoppers is 15 nymphs per leaf, more conservative than the UC-developed threshold of 20 nymphs per leaf. Only 8 vineyards below this threshold received an application in 1998, and 10 in 1997, whereas 14 vineyards were sprayed below threshold in 1996. This result shows that intensive monitoring and discussion of threshold levels can reduce the use of chemicals for leafhopper control.

Figure 2 Leafhopper Nymph Counts per Leaf for Vineyards Sprayed with Provado: 1996 to 1998
Modified from Figure 5, Final Report, page 29



Spider Mites

In 1996, there were few BIFS vineyards with mite populations that exceeded the economic threshold and six BIFS vineyards were sprayed. However, in 1997 the mite pressure was much higher and 21 vineyards were sprayed with propargite (Omite®). In the following year, mite populations returned to levels similar to those seen in 1996, and six BIFS vineyards were sprayed (see Figure 10 and 11 in Lodi-Woodbridge BIFS Final Report, page 35). An important element of BIFS projects is that in addition to monitoring for pest species, beneficial species were recorded and in some vineyards growers were able to hold off applications of miticides until the resident predaceous mites controlled the pest mite (Figure 3).



Diseases

Powdery mildew can be a devastating disease in winegrapes, and once an infection occurs it is very difficult to manage. Therefore prophylactic spraying is used to manage this disease. Because of the importance of this pathogen most growers have a very rigorous treatment program and as a result no mildew problems occurred in any of the BIFS vineyards. However, the piggyback research project, Pestcast, has enabled BIFS growers to monitor weather variables and through the use of predictive models make disease management decisions based on this data, thereby reducing the use of fungicides in some seasons.

Bunch rot is a complex of pathogens that becomes important in winegrapes after the sugar in the grapes begins to rise rapidly (about mid-summer). Levels of infection depend on a complex of factors such as weather conditions, presence of damage to the grape bunches, and canopy microclimate. The practice of leaf pulling is very important in reducing bunch rot problems. During the three years of the BIFS project, approximately 50 percent of the growers used leaf pulling in their vineyards, no significant increase or decrease in the use of the practice seems to have occurred.

Summary and Assessment of Pesticide and Fertilizer Use

A consultant working with the Lodi-Woodbridge BIFS project coordinator and the UC SAREP BIFS coordinator obtained and analyzed 1992-1995 pesticide use data from the Department of Pesticide Regulation (DPR) for winegrapes in San Joaquin County. These data were used to determine county pesticide use averages for winegrapes and were then compared to the averages in vineyards enrolled in the Lodi-Woodbridge BIFS project. The Lodi-Woodbridge BIFS project coordinator also obtained 1996, 1997, and 1998 pesticide use data for the BIFS vineyards directly from the participating growers. Comparisons were made among BIFS enrolled vineyards (BIFS enrolled), BIFS growers' vineyards not enrolled in the BIFS project (BIFS non-enrolled), and the rest of

the Non BIFS growers in San Joaquin County (non BIFS). Data from 1992 through 1995 is prior to the initiation of the BIFS project and can be looked at as pre-project use patterns. Data for 1996, 1997, or 1998 are still not available from DPR. Nevertheless, pesticide use data from the BIFS project enrolled vineyards for these years was summarized using the Lodi-Woodbridge BIFS database and has been included in the analyses.

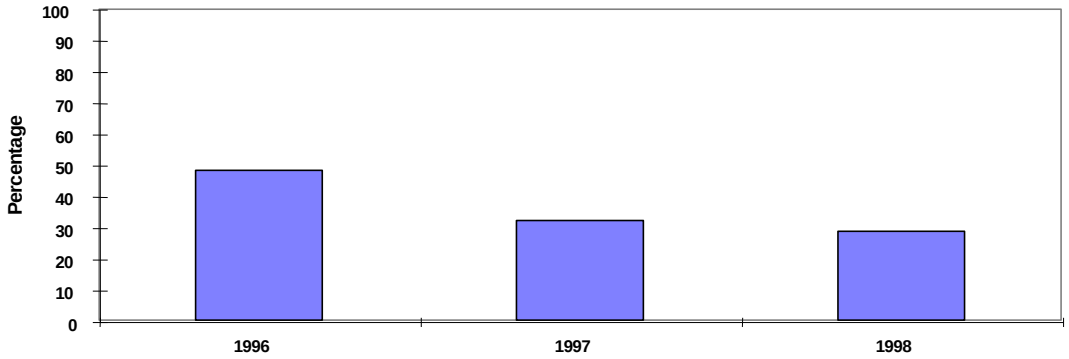
Pesticide use data can be presented in different ways; the Lodi-Woodbridge BIFS project presented data as 1) Total amount of active ingredient (a.i.) applied per acre during the year, (calculated by taking the total amount of the chemical used that year and dividing it by the total vineyard acreage i.e. both treated and untreated); 2) Proportion of growers applying a particular chemical; and 3) Proportion of the total vineyard acreage receiving the particular chemical.

Insecticides

The use of most organochlorine (OC), carbamate and organophosphate (OP) pesticides in the Lodi-Woodbridge BIFS, pesticides under reevaluation under the Food Quality Protection Act of 1996 (FQPA), is very low and has been since before 1992. The use of Dimethoate®, Lannate® (methomyl), and Sevin® (carbaryl) has declined to almost zero in all grower groups from 1992 to 1996 (Figs. 18a-c in the Lodi-Woodbridge BIFS Final Report, page 47). Dimethoate® and Sevin® were not used at all in the BIFS vineyards, once the project started in 1996, and the use of Lannate® declined to zero in 1997 (Fig. 18a-c in the Lodi-Woodbridge BIFS Final Report, page 47). In 1995 a new insecticide, Provado® (imidacloprid) was registered for use against grape and variegated leafhoppers in California. This material has proven to be very effective against both leafhopper nymphs and adults. It is required in very small amounts (0.75 oz or less) and appears to be much less environmentally disruptive than the OP's and carbamates. The re-entry time into the vineyard after treatment and the pre-harvest interval is only 24 hours so many growers are willing to watch leafhopper populations develop before treating them, knowing that they can treat right up until harvest if numbers become unacceptable. This has resulted in many growers using sound economic thresholds in leafhopper management.

Figure 4 presents the percentage of BIFS growers using Provado® which declined from year 1 through year 3 of the BIFS project (Fig. 19a in the Lodi-Woodbridge BIFS Final Report, page 49). In 1996, 51 percent of BIFS vineyards were sprayed for leafhoppers, while in 1997, 28 percent were sprayed, and by 1998, the proportion sprayed had decreased to 18 percent (see Figure 2). This occurred despite the leafhopper numbers being similar in both growing seasons (Fig. 4 in the Lodi-Woodbridge BIFS Final Report, page 28). This is strong evidence that some BIFS growers that treated for leafhopper in 1996 tolerated higher leafhopper numbers in 1997 and 1998. This result emphasizes the importance of stressing monitoring in any BIFS project because it can result in pesticide use reduction. In each of the three years of the project, at least half of the BIFS growers did not treat for leafhoppers (Figure 2).

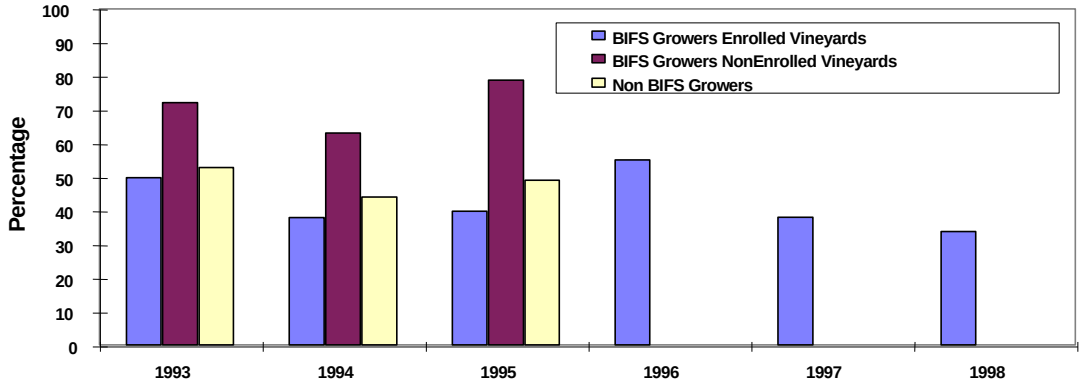
Figure 4 Percentage of BIFS Growers Using Provado® (imidacloprid)
From the LWWC BIFS Final Report, Figure 19a, page 49



Herbicides

Simazine (Princep®) is a pre-emergence herbicide that has been found contaminating ground water in some parts of the Central Valley of California. It is a very cheap and effective material and many growers are reluctant to stop using it for these reasons. From 1993 to 1995, before the BIFS project began, the proportion of the vineyards treated with simazine was fairly constant within the different categories of growers. It is interesting to note that between 70-80 percent of the BIFS growers were using simazine on their non-BIFS acreage, more than the rest of the county's growers where approximately 50 percent were using simazine. However, the product's use has declined on BIFS enrolled vineyards through each of the three years of the BIFS project (Figure 5). The use of the other 4 pre-emergence herbicides (oryzalin, oxyfluorfen, norflurozon, and diuron) has declined significantly during the life of the project.

Figure 5 Percentage of Growers Using Simazine
From the Final Report, Figure 22a, page 54



Evaluation of the Project in Meeting Integrated Farming Systems Standards

The Lodi-Woodbridge BIFS project developed a survey to evaluate the progress of the Lodi-Woodbridge Winegrape Commission's BIFS/IPM project from its inception in

1992. The BIFS project has been the Commission's primary focus from 1996 through the end of 1998, so that much of the data from the survey is indicative of the success of the BIFS project and the BIFS approach to integrated farming implementation. The term IPM was used in the survey, rather than BIFS, due to the district wide recognition of the term IPM and because the project was initiated as an IPM program. This survey addressed grower attitudes, perceptions, and degree of adoption of integrated farming systems. Returned (completed) questionnaires totaled 288 out of 608 originally mailed out. The survey response rate was 47 percent with a ±5 percent sampling error rate.

Forty-seven percent of the growers have had some contact with one of the 43 BIFS growers and just over half have talked with the Lodi-Woodbridge BIFS staff (Figure 37, Lodi-Woodbridge BIFS Final Report, page 65). Five out of the top six sources of information rated by respondents as their most important source of information were "people sources." The most important source was their PCA, followed in order of importance by other growers, Farm Advisors, field crew, and winery personnel (Figure 46, Lodi-Woodbridge BIFS Final Report, page 73). This confirms the value of the BIFS method of emphasizing what has been called a "farmer-to-farmer" approach to technology/information transfer. Sixty-five percent of the growers have attended a NGM, showing the extent of this kind of outreach activity during the BIFS project (Figure 38, Lodi-Woodbridge BIFS Final Report, page 66).

Respondents were asked if they had changed the amount or type of monitoring since the establishment of the Lodi-Woodbridge BIFS/IPM project in 1992 (Figure 41, Lodi-Woodbridge BIFS Final Report, page 68). Two-thirds of the respondents (66 percent) reported monitoring their vineyards more frequently since 1992. Sixty three percent said that they increased their monitoring for beneficial organisms. Over half the respondents spend more time monitoring their vineyard per visit since the start of Lodi-Woodbridge BIFS/IPM project and 49 percent said that they are monitoring more systematically. Sixty five to sixty-eight percent of the growers are using monitoring and economic thresholds for leafhoppers and mites, respectively, while 82 percent used monitoring and need-based spraying for weeds (Figures 47, 48, and 50, Lodi-Woodbridge BIFS Final Report). Fifty-eight percent of the respondents monitor for predacious mites. This indicates that the BIFS/IPM project has had a significant impact on growers' monitoring habits.

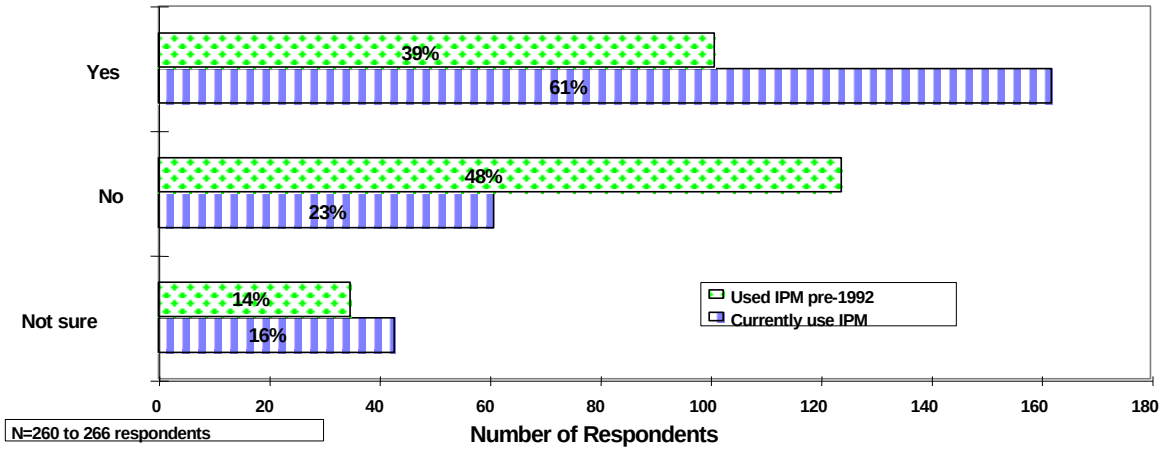
Respondents were given a list of IPM practices promoted by Lodi-Woodbridge BIFS for insect, mite, disease and weed management and asked which of these practices they have used. Reducing the per acre rate of pesticides with conventional spraying equipment was the strategy used by over three-quarters (76 percent) of the growers for insect control, 65 percent for weed control, and 58 percent for mite control. If the average grower reduces the rates of insecticides when spraying this will have a large impact on
overall pesticide use reduction. For example, if every grower were to use 25 percent less pesticide when they treat then we will have reduced pesticide use by 25 percent. A third of the growers use alternate row spraying when treating insect problems. Just by spraying every other row rather than spraying every row, insecticide use is reduced by 50 percent. Sixty five percent of LWWC growers use leaf pulling as an IPM strategy

(Fig. 47 and 49 Lodi-Woodbridge BIFS Final Report, pages 74 and 76). Leaf removal is a cultural control practice that reduces the amount of disease (Botrytis bunch rot) but also reduces leafhopper nymphs and spider mite problems. Almost half of the growers in LWWC (46 percent) have cover crops.

Comparing the results of the LWWC grower survey presented above with Table 9 data from the 60 BIFS growers' demonstration vineyards we can see that the BIFS demonstration vineyards still serve as model vineyards in two key areas, monitoring and use of cover crops. One-hundred percent of the demonstration BIFS vineyards are monitored weekly for insects and mites compared to 65 to 68 percent of the LWWC growers. Seventy-two percent (combining annual and perennial cover crops) of the BIFS growers use cover crops whereas only 46 percent of the LWWC growers use them.

Respondents were asked if they used IPM/BIFS practices in their vineyards before the LWWC project began in 1992 and if they are currently using IPM/BIFS practices for their vineyard pest management. Thirty nine percent of the growers said they were using IPM before 1992 and 61 percent said they are currently using IPM (Figure 6). Almost half the growers felt they were not using IPM before 1992 while only 23 percent said they are not now. The Lodi-Woodbridge BIFS project has had a significant impact on the numbers of growers practicing integrated pest management in the district.

Figure 6 Are LWWC Growers Using IPM? From Figure 53 of the LWWC Final Report, page 79



Summary of the Annual Review

The following paragraphs summarize conclusions from the 1997 annual review meeting and subsequent analysis by UC SAREP of the Lodi-Woodbridge BIFS project based on the final report:

> The in-season pest monitoring program is a strong point in this project. All fields enrolled in the project were monitored weekly during the season for key biological indicators important for pest management. Pest management decisions were based on this data and reductions in use of pesticides can be related to this intensive monitoring. Monitoring for soil biological indicators can be improved.
>
> The development of a data management system (the relational database) and the scope of information monitoring entered into this database is an outstanding accomplishment. This system should be adapted to other BIFS and BIFS-style projects.
>
> In 1996, baseline data on the previous years' crop yields, fertilizer and pesticide use were not reported. The project supervisor was directed to collect and analyze these data and to submit them to UC SAREP by June 30, 1997. The pesticide use data for BIFS growers was presented from 1992 through 1998 however data of county growers for comparison was only presented for 1992 through 1995 as this was the most recently available data from the Department of Pesticide Regulation (DPR). This pesticide use data was summarized and presented in the 1997 annual report and the final report. However, the most important comparison, between BIFS growers and non-BIFS growers in the county for the years that the BIFS project was active, has not been presented. BIFS growers' fertilizer use data was provided in the final report, however no comparison with county average use data was presented. For winegrapes, the amount of synthetic nitrogen fertilizer used is relatively low compared to other crops in the area, and fertilizer use associated with winegrapes has not been found to impact ground water quality. Yield data has not been presented for the BIFS growers or for county comparisons; the BIFS project manager was asked for this data but did not provide it.
>
> It should be noted that this project did not maintain side-by-side comparison plots over the three years. Instead, the project was designed more to support intensive on-farm monitoring and in-season decision making rather than obtaining data from conventionally managed comparison plots. The comparison of BIFS grower's agricultural chemical use patterns with county averages can be an acceptable approach for analyzing impacts of a project, however, all relevant comparisons need to be done.

WEST SIDE BIFS

This section summarizes the West Side BIFS project using excerpts from the West Side BIFS Final Report and Annual Reports from 1997 and 1998. Complete copies of these reports are available upon request.

The West Side of the San Joaquin Valley is one of the most productive agricultural regions in the world, extending more than 200 miles from Los Banos in the north to Bakersfield in the south. This region has undergone considerable change in cropping rotations during the last 30 years, with an ever-increasing trend toward land planted to row crops of higher value like cotton and vegetables. A number of farmers in the region feel that this intensification of cropping has led to a decline in soil quality and increased pest management problems.

In 1995, 14 West Side farmers, in cooperation with research and extension advisors from the University of California and other private and public agency consultants, initiated the West Side On-Farm Demonstration Project ("West Side BIFS") to address these concerns. The project was established to evaluate biologically integrated soil building and pest management practices within a participatory and on-farm demonstration context. The project has secured over $208,000 in adjunct research funding since it was started in 1995 and is serving as a key test site for the development of a soil quality index and stimulating interest in conservation tillage in California.

GROWER OUTREACH

Workshops, Field Day, Seminars

Fundamental to education are the workshops and seminars presented at West Side Research and Education Center (REC) in Five Points where West Side growers and PCAs can conveniently interact with speakers from the University of California. Continuing education hours for PCAs were provided for pest management seminars that were also summarized for those unable to attend.

Since 1995, 21 meetings have been held in conjunction with the project, and through these gatherings, an estimated 500 connections between West Side BIFS project staff and participants have been made. BIFS events have included technical conferences, seminars and field demonstration meetings. Sample topics included weed management, use of cover crops on West Side farms, and use of cowpea buffer strips for Lygus management. One of those meetings was the soil quality conference held at West Side REC on April 22, 1998. Over one hundred people attended the conference that provided a forum for exchanging information and developing new ideas on soil quality management. Later in 1998, a pest management seminar series was held entitled *Integrating Biology Down on the Farm.* The topics addressed included: Regional Approaches to Managing Insect Pest Problems, Augmenting Natural Enemies in Cotton Fields, and Current Issues in Cotton Insect Pest Management. The meetings received 9 hours of PCA continuing education credit and were attended by 30 people over the three-month period.

Management Team Meetings

A management team consisting of UC Extension, USDA Natural Resources Conservation Service (NRCS), mentor farmers, and private consultants has guided the development of the project and has been closely involved in the delivery activities and the identification of satellite projects. Project-wide planning meetings have taken place annually during which progress is reviewed and future plans defined. Management team meetings were open to all participants and discussion summaries were provided in the BIFS Newsletter. The West Side BIFS Coordinator made sixty-six individual contacts in 1998. Arthropod consultations were estimated at 30 during the summer of 1998.

Newsletters

The BIFS Newsletter is an outreach tool that keeps the BIFS participants informed as well as reaching audiences beyond the West Side. The newsletter currently reaches over 90 participants. A total of 9 issues were developed during the project. As part of the pest management information sharing, a second newsletter titled *Out Standing in Your Fields* was developed in 1997 and provided a weekly summary of insect and mite populations over time, as well as pest management guidelines. A total of twenty-two of these summaries were provided to participants, PCAs, consultants, and other interested parties in 1997 and 1998. The West Side BIFS 1997 Annual Report, attachment 4, contains a copy of *Out Standing in Your Fields*.

Presentations on the BIFS Project

The high visibility of the West Side BIFS Project has attracted considerable interest from farmers outside the San Joaquin Valley as well. In 1997, Jeff Mitchell was invited to present overviews of the project to San Benito County growers (50 participants), to the Progressive Farmers, a group of row crop farmers in Coachella Valley as part of the First Annual Cover Crop Field Day held in Indio, CA on July 30 (30 participants), and to a group of rice extension researchers working with farmers in the Sacramento Valley (10 participants). In 1998, the project's progress has been summarized by in-person presentations to 3 groups that are considering organizing similar participatory projects, 4 national meetings and 1 commodity field day. Support to extend the results of the West Side BIFS Project to other California tomato-growing regions has also been granted by the California Tomato Research Institute ($1,000).

IMPLEMENTATION OF PRACTICES

Biologically Integrated Soil Management Practices

The fourteen farms participating in the West Side BIFS farm a total of approximately 90,000 acres. Each farm has dedicated one or more field sites of 80-160 acres for the BIFS on-farm demonstrations—a total of 1,653 acres in 16 field sites. The sites consist of two adjacent 40 to 80 acre blocks at each farm. One block is conventionally managed with the other block receiving a biologically based treatment.

Organic soil amendments, including manure and compost applications and cover crops, were used by 75 percent of growers over the course of the project. In the first project year, 87.5 percent of enrolled growers included one of these alternative soil management practices in their BIFS sites; in the following two years, 68.75 percent of growers used these alternative practices. Conventionally managed comparison plots did not receive organic soil amendments or cover crops. Within Fresno County, only an estimated 5 percent of growers use these alternative soil management practices in their fields. In all years, the use of compost or manure was more common than planting a cover crop. In 1996, 1997, and 1998, twelve, seven, and eight farmers used compost or manure, while two, six, and three, respectively, planted cover crops. On-farm demonstrations and evaluations of practices aimed at improving soil quality were continued in 1998 at eleven of the original sixteen sites (Table 10). The addition of these organic soil amendments is intended primarily as a means of conditioning the soil and for improving overall soil quality, rather than for fertility purposes or as a means of reducing fertilizer inputs.

Soil sampling was conducted in the spring and fall of each growing season. Soil quality data from 1998 are presented in the West Side BIFS Final Report, pages 30-37 and data from 1997 are presented in the West Side BIFS 1997 Annual Report, pages 14-17 .

A cover crop planting date study was undertaken as part of the demonstration project. Ten different cover crop species or combinations of species were planted for two years at monthly intervals from August 1 through November 1 to evaluate the best species and time of planting for the West Side conditions. Very different amounts of biomass were produced with the different species and times of planting (see Figure 1, West Side BIFS 1998 Annual Report, page 19). This on-farm locally generated data can be used to immediately incorporate cover crops into the West Side of the San Joaquin Valley production systems.

Table 10. Alternative soil management practices and cropping plans on West Side BIFS sites, 1996-1998, from West Side BIFS 1998 Annual Report, Table 1, page 7.

Farm/Ranch (anonymous code)	Yr. 0 BIFS Treatment	96 Crop	Yr. 1 BIFS Treatment	'97 Crop	Yr. 2 BIFS Treatment	'98 Crop
BRITZ	Compost/ Chicken man.	Tomato	Cover crop/Sudan grass	Cotton	none	Cotton
FARMING "D"	Compost/ Turkey man.	Tomato	Turkey manure	Garlic	manure	Cotton
FARMING "D"	Compost/ Turkey man.	Tomato	Turkey manure	Garlic	none	lettuce
FARMING "D"	Cover crop/Barley	Tomato	Turkey manure	Garlic	manure	Cotton
5 PTS RANCH	Compost/ Gin trash	Tomato	Sudan grass/Gin trash	Onions	Compost/ Gin trash	Cotton
5 PTS RANCH	Compost/ Gin trash	Cotton	Compost/ Gin trash	Tomato	Compost/ Gin trash	Garlic
HARRIS RANCH	Compost/ Cow man.	Tomato	Compost/ Cow man.	Garlic	Compost/ Manure	Cotton
J & J Farms	Compost	Tomato	Cover crop/Barley	Cotton/ Melons	none	Cotton
LOWE	Compost	Tomato	Cover crop/Barley	Cotton	none	Cotton
O'NEILL	Gin trash/man.	Tomato	Gin trash/man.	Cotton	Compost/ Gin trash	Cotton
WOOLF	Compost	Tomato	Sudan grass/Cow man-yard waste	Tomato	Sudan grass	Cotton
BORBA FARMS	Cover crop	Field Corn	Fallow	Cotton	Dairy manure	Cotton
TERRA LINDA	Compost/ Britz	Tomato	Fallow	Cotton	none	Tomato
TERRA LINDA	Cover crop/Wheat	Tomato	Fallow	Garlic	Wheat cover crop	Cotton
DRESICK	Fallow	Lettuce	Rye	Melons	Rye	Lettuce
RED ROCK RANCH	Compost	Tomato	Poultry man./ Compost-Foster Farms	Melons	Compost/ Manure	Tomato

Interviews with the BIFS participants revealed that PCAs have an extensive role in the overall pest management in West Side cotton production. Of the 12 farmers interviewed in 1997, 11 used at least one PCA and 6 used two or more. Of the PCAs utilized, five were reported to be independent, four were on salary with the farm (in-house), and eight were affiliated with dealers or retail farm suppliers. The majority of the PCAs were involved during the entire production cycle, from pre-plant decisions to harvest. All eleven farmers who used PCAs reported their PCAs to be "very involved" in insect pest management while fewer farmers reported their PCAs to be "very involved" in disease and weed pest management, 8 and 5 farmers respectively. The majority of the farmers said that PCAs conducted regular, scheduled visits to the farm at least twice a week during the growing season and reported information at least weekly. The majority of these farmers received formal reports. All but one of the farmers indicated they share joint responsibility with their PCA for pest management action decisions.

BIFS Pest Management Practices

In 1997 and 1998, intensive weekly monitoring of pests and beneficial species of insects was performed to evaluate the pest management implications of the on-farm biologically based soil management practices. Table 11 and 12, obtained through the end of year grower survey, list the biologically integrated insect and weed management practices demonstrated by the project, the number of growers that incorporated each practice, and the number of years in use. Practices in bold typeface in these two tables are newly adopted within the timeframe of the BIFS project.

Table 11. BIFS practices in cotton insect IPM, percent of sites incorporating these practices (n=10), and the number of years in use. From Table 6, West Side BIFS Final Report, page 61 and Table 3, West Side BIFS 1998 Annual Report, page 28.

Suggested Insect IPM Practice	Percent Now Using	Average No. Years in Use
Plant cotton according to soil temperature and five-day forecast	100	9.3
Planting at densities no more than 45,000 – 55,000 plants/ac*	60	--
Use of resistant varieties where appropriate and available*	80	--
Twice weekly inspections for insects and mites	100	6.4
Pest density to reach action thresholds before pest control	90	9.7
Follow 1998 Insecticide Resistance Management Guidelines	90	6.1
Monitor insecticide resistance with bioassays	70	11.6
Use of cowpea buffer strip on upwind edge of field	50	**1.8**
Release of natural enemies	30	**1.7**
Conservation of natural enemies	100	11.3
Consider the condition of neighboring crops for managing pests	90	9.5
Crop termination as early as dictated by plant monitoring indices	90	8
Attend UCCE summer production meetings and BIFS field days	100	8.2
Provide alternative habitat for natural enemies	20	8

* Data regarding the use of these practices were taken from field reports, n=5

Table 12. BIFS practices in weed IPM, percent of sites incorporating these practices (n=10), and the number of years in use. From Table 7, West Side BIFS Final Report, page 62 and Table 4, West Side BIFS 1998 Annual Report, page 29.

Suggested Weed IPM Practice	Percent Now Using	Average No. Years in Use
Use of light activated sprayer	20	**3**
Using an in-row cultivator (Bezzerdies)	20	11.5
Deep plowing for burial of weed seeds and nutsedge tubers	50	4.4
Foregoing Treflan® in fields with low weed pressure	90	4.7
Using Treflan® at variable rates at layby in tomatoes	40	**3.7**

Insect Management

The use of cowpea buffer strips was fully demonstrated in 1998 in six BIFS fields. This approach increases the biological intensity of cotton pest management by providing an alternate host for Lygus, reducing the area requiring broad-spectrum insecticides, and conserving natural enemies. Six fields were planted with California black-eye bean strips 40 feet wide on the upwind side of the cotton field. The on-farm plots demonstrated the concept was feasible and performed adequately (Figure 4, West Side BIFS 1998 Annual Report, page 27), but did not live up to all expectations. Lygus migration occurred across a wide front and was not limited to the upwind border. Timing of the migration, stage of bean development, and irrigation timing are all crucial for maximum attractiveness. The BIFS growers feel that the concept has merit but is not very effective in its current form.

In 1998, four releases of green lacewing (Beneficial Insectary, 14751 Oak Run Rd, Oak Run CA 96009) were made at a rate of about 10,000 eggs per release. Releases were made according to insectary guidelines and placed in or near the buffer strips. These releases were made during July and August.

Weed Management

Weed management practices demonstrated include variable rates of Treflan®, introduction of a new "smart sprayer," and physical control of weeds, such as burning and cultivation, or burial. Variable rate layby application of Treflan® involves replacing nozzles in the incorporator close to the tomato row with nozzles of less gallonage, resulting in less material applied close to the plant. The bed shoulder receives the highest concentration and there is less herbicide needed at the tomato row because the tomato is a rapidly growing crop after layby and it quickly shades weeds close to the crop row. Treflan® use can be reduced 40 percent to 60 percent depending on how the incorporator is set up. Reducing the amount of Treflan® saves the farmer money and decreases the residual amount in the soil which reduces the chance of injury to a grass cover crop that a grower may want to use following tomatoes.

Another weed management practice used is the light-activated sprayer to apply post-emergence materials. The Patchen sprayer was introduced and demonstrated in the BIFS community. It uses sensor-activated nozzles that apply herbicide only when green plants are detected. It can replace broadcast applications that apply much of the product on bare ground. The current use is in cotton for control of bermuda grass and field bindweed. The herbicide used is Roundup® for either weed or Prism® for bermuda grass. Reduction in herbicides is estimated at 40 percent to 80 percent[2]. Ron Jones of J & J Farms and the manager at Borba Farms both feel they have reduced their use of herbicides by 60 percent to 80 percent with this technology.

PIGGYBACK RESEARCH

[2] Prather, T.S. 1996. Potential herbicide savings using a light activated sprayer in row crops. Plant Protection Quarterly, 6:1:3-5.

A wide range of adjunct projects totaling $208,000 is either underway or being proposed for the West Side BIFS projects. These include: Effects of Organic Compost on Cotton Nitrogen and Soil Physical Properties, Sustainable Methods to Control Soilborne Diseases of Tomatoes, Integrated Management of Soilborne Diseases and Aphid Transmitted Viruses in California Vegetable Crops--An On-Farm Demonstration, Using Buffer Crops to Protect Cotton from Lygus, Survey of Arthropod Fauna in San Joaquin Valley Cotton, Planting Date Evaluations of Prospective Late Summer Cover Crops for the San Joaquin Valley Row Crop Systems, Nitrogen Mineralization from Organic Amendments, Use of Cover Crop Mulches in Tomato Production Systems, and Applying Variable Rates of Treflan® at Layby in Tomatoes.

DOCUMENTATION AND EVALUATION

This section (as required in Section 597 of AB 3383) provides "an analysis of the monitoring activities, a summary and assessment of pesticide and fertilizer use data, and an analysis of the success of each project in meeting the standards for integrated farming systems." This section is based on summarizing the West Side BIFS project's own impact assessment activities and the second annual review by the program advisory review board, UC SAREP Director and staff. In addition, it includes an evaluation of the West Side BIFS Final Report by the UC SAREP Director and staff.

Analysis of Monitoring Activities

This project was very successful at monitoring the side-by-side comparisons of conventionally managed and biologically integrated production systems. Intensive monitoring of soil chemical, physical, and biological factors was performed each year in these plots.

Soil Quality Monitoring

A number of soil properties and sampling times have been selected for monitoring changes in soil quality. Soil samples were taken from the alternative and conventional fields of each participating farm in the spring and fall of each project year. Soil physical properties monitored included: bulk density, water stable aggregates, water-holding capacity, water infiltration rate, particle size distribution, and penetration resistance. Soil chemical properties monitored included: pH, electrical conductivity, cation exchange capacity, extractable Na, Ca, Mg, K, and P, total soil carbon and nitrogen, inorganic N (NH_4^+, NO_3^-), sodium adsorption ratio (SAR), and percent organic matter. Key soil biological properties included dehydrogenase activity, potentially mineralizable N, earthworms, microbial activity and cloth strip decomposition, microbial biomass carbon and nitrogen, and phospholipid fatty acid analysis. Pages 30-40 in the West Side BIFS Final Report provide further details on soil quality sampling and analysis.

Initial samples taken in 1996 revealed no significant difference ($p<0.05$) between the conventional and alternatively managed plots in their initial values for soil pH, electrical conductivity (EC), cation exchange capacity (CEC), soil organic matter (SOM) and total N values in each agricultural system. This result suggests that the alternative and

conventional systems were allocated to homogeneous fields. However, samples taken in 1998, almost three years into the project, revealed some significant differences ($p<0.05$) among the soil quality indicators. Those soil quality measures that showed the most consistent increases in alternatively managed sites included total soil carbon, microbial biomass carbon and nitrogen, exchangeable potassium and organic matter (Figures 7, 8, and 9). After almost three years of alternative management, all sites showed significant differences in at least one soil quality indicator. The West Side BIFS project coordinator also compared the impacts of conventional soil management to those of a nine-year organically managed soil and found significant differences in eleven of twelve soil quality indicators. The improvements in the organically managed soil, after nine years of certified organic production, indicate that changes in soil quality occur over time and may not be initially apparent.

Figure 7. Percent soil organic matter from individual BIFS sites (conventional and alternative practices), and from three farms with multiple alternative management practices. From page 31, West Side BIFS Final Report.

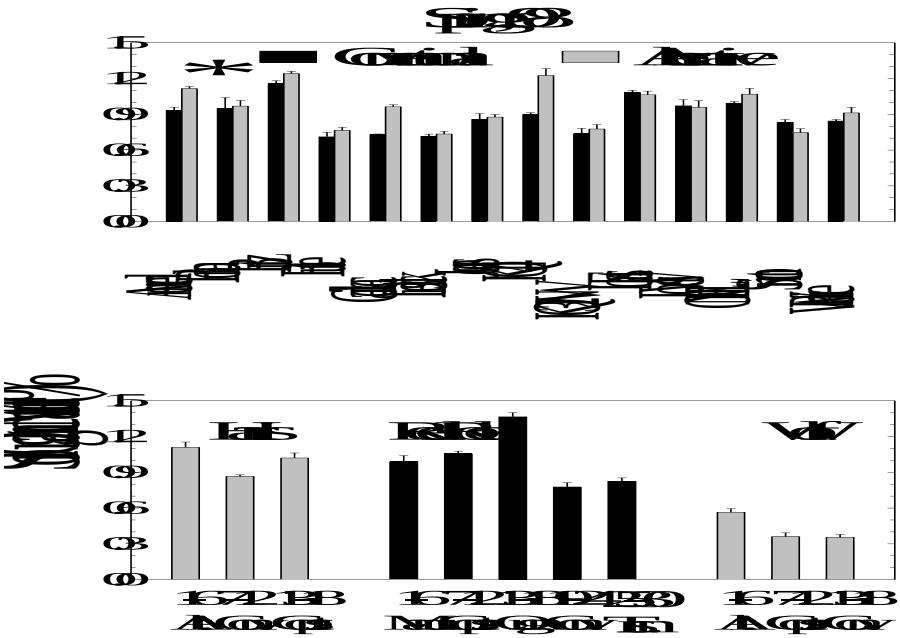


Figure 8. Microbial biomass carbon from individual BIFS sites (conventional and alternative practices), and from three farms with multiple alternative management practices. From page 32, West Side BIFS Final Report.

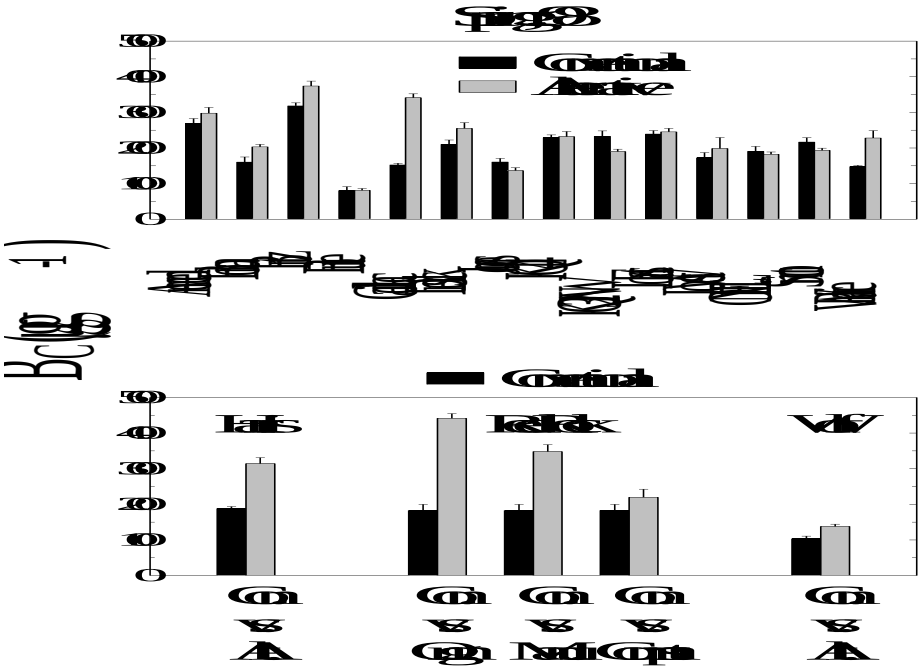
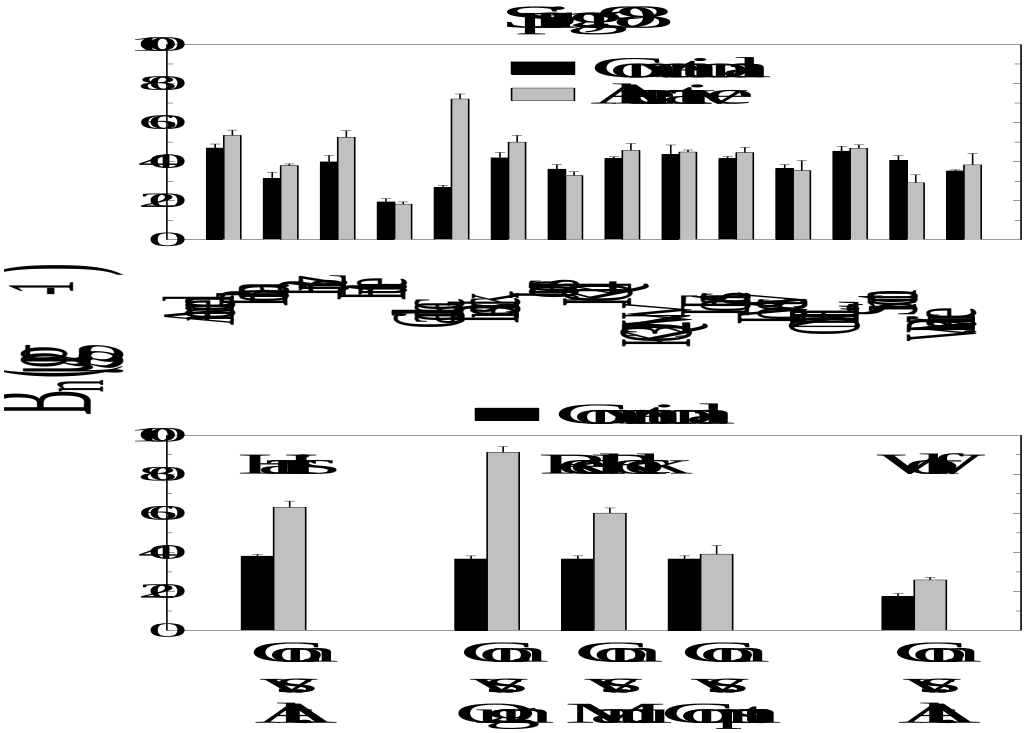


Figure 9. Microbial biomass nitrogen from individual BIFS sites (conventional and alternative practices), and from three farms with multiple alternative management practices. From page 31, West Side BIFS Final Report.



The extensive soil quality indicator property monitoring that has been conducted through the West Side BIFS Project and the UC Davis campus-based Sustainable Agriculture Farming Systems (SAFS) Project, provides outstanding datasets that are currently being used to develop a soil quality index. The goal of this project is to subject a Principal Component Analysis-identified subset of the BIFS and SAFS datasets to scoring functions that will create a ranked list. The ranking will also take into consideration the specific soil management goals of Central Valley farmers in order to generate a soil quality index. This will provide growers with a tool to conduct a semi-quantitative assessment of the quality of their soils relative to specific management goals, such as productivity or environmental conservation.

Compost and Manure Sampling and Crop Stand Establishment after Cover Crops

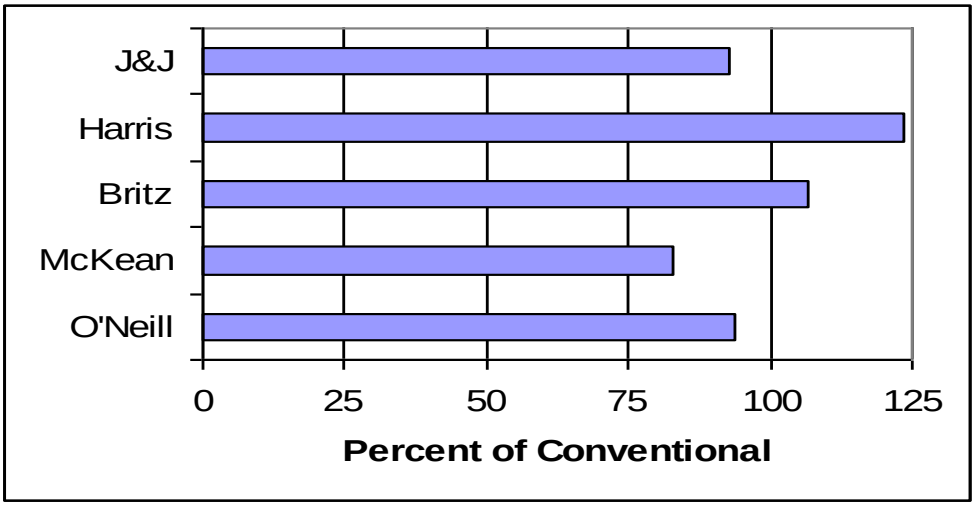
Representative compost samples were supplied by the BIFS participants and submitted to the DANR Analytical Service Laboratory for total content of C, K, Na, P, Ca, Mg, organic carbon and nitrogen, and total N (see Appendix 2, West Side BIFS Final Report). Based on the total compost N, and the soil P and K values, a guideline was prepared by the technical team and given to each grower for possible adjustments in their fertility programs. Crop plant stand counts were performed each year after the cover crop treatments to evaluate the impact of these organic matter amendments on seedling health and stand establishment.

Soil amendments, including plant-wastes, manure, and combinations of the two, varied among type in their net N mineralization rate. Plant wastes mineralized 4 percent or less of the total N present, mixtures of plant waste and manure mineralized 5-10 percent, and aged manures 10 percent. These results showed much slower N mineralization rates than many cited references show, but are consistent with growers' experiences suggesting that organic soil amendments have more significant long term effects than was previously presented in the literature.

Productivity and Product Quality Measures

After three years of side-by-side treatments, the 1998 cotton yield estimates show some interesting results (Figure 10). Since location and individual production practices might affect data, results are expressed as standardized percentages of the BIFS divided by conventional. The bar at 100 percent represents equivalent yield. Yield estimates from hand-picked 1/1000th-acre samples indicated that two of five farmers had slightly greater cotton yield in the BIFS plots than in conventional, and at three sites BIFS plots slightly under-yielded conventional. Care must be taken in interpreting these differences as a result of only BIFS practices. However, it should be noted that the more biological approach did not result in a general yield decline.

Figure 10. BIFS cotton yields contrasted to conventional yields in 5 fields in the West Side. Results expressed as a percent of conventional. Adapted from Figure 6a, West Side BIFS 1998 Annual Report, page 32.



Determinations of postharvest crop residues in West Side BIFS rotations

Crop residue biomass collected throughout the West Side region from 1996 to 1998 ranged from 9,560 lb. per acre for corn following grain harvest to 570 lb. per acre for onions (West Side BIFS 1997 Annual Report, page 22). This data point to a very large range of organic matter recycling that results from various intensive cropping strategies in the West Side region and may be useful in determining optimal rotation schemes.

Though rotation decisions ultimately depend on economic factors, judicious crop rotations may be a means for sustaining soil organic matter, in addition to the deliberate use of amendments such as compost, manure and cover crops.

Tillage on the West Side

A 1998 survey of BIFS farmers indicated that pre-plant tillage costs average about 22 percent of the total cost of producing a crop in the West Side. While there are variations depending on the preceding crop, soil type and subsequent crop, typical tillage and land preparation practices for processing tomatoes and cotton result in approximately 12 different tillage operations across fields (Table 1, West Side BIFS Final Report, page 20).

Reducing tillage in West Side cropping systems is generally seen as a desirable goal, however, information is not available on how best to implement a conservation tillage (CT) program. Two informational meetings were held by the BIFS project during 1998 to initiate dialogue and provide pertinent background information on this topic, and to develop on-farm evaluations of CT practices.

IPM Activities

Starting in 1997 and continuing in 1998 the BIFS cotton fields were sampled weekly for major insect pest and beneficial species. This information was faxed to the grower and PCAs as well as sent out weekly as a newsletter entitled *Out Standing in Your Fields* (West Side BIFS 1997 Annual Report, attachment 4). In addition, during the 3 years of the project, populations of tomato, onion and garlic insect pests were also monitored using UC sampling guidelines. This data was collected on the side-by-side plots to investigate if the organic soil amendments had any impact on pest species. In cotton, monitoring of Lygus and other insects was also done on the cowpea strip crops to evaluate the impact of this management strategy on pest numbers (West Side BIFS Final Report, Figure 22, page 60).

Summary and Assessment of Pesticide and Fertilizer Use

Pesticide Use

Pesticide use data was obtained for pre-project years (1992-1996) from the County Agricultural Commissioner. The project looked at pesticide use in three ways: as acres treated divided by planted acres (treatment acres), as pounds active ingredient applied per acre (ai/acre), and as number of pesticide applications. In 1993, before the BIFS project, acreage treated by BIFS growers did not differ greatly from county-wide patterns (see West Side BIFS 1997 Annual Report, Figure 4, page 33).

From annual farm management plans, the project collected data on the number of applications of insecticides/miticides made by BIFS growers in 1997 and 1998. In 1997 these growers used a total of 13 applications on the conventional side and 12 on the BIFS. In 1998, pesticide use doubled for both farming systems; BIFS plots received 26 applications and the conventional received 29. In 1997 insecticide applications, the

amount of ai/acre was similar among BIFS and conventional sites, although one grower used half as much insecticide on BIFS acreage (Figure 11). In 1998, however, three of five BIFS sites received less ai/acre than their conventional comparisons (Figure 12). While number of insecticide applications was similar, by 1998 BIFS sites received less pesticide than the paired conventional sites.

Figure 11. Pounds active ingredient of insecticides applied per acre of treated cotton sites in 1997. (From West Side BIFS Final Report, Figure 23b, page 64). Individual farms are represented as anonymous letter codes.

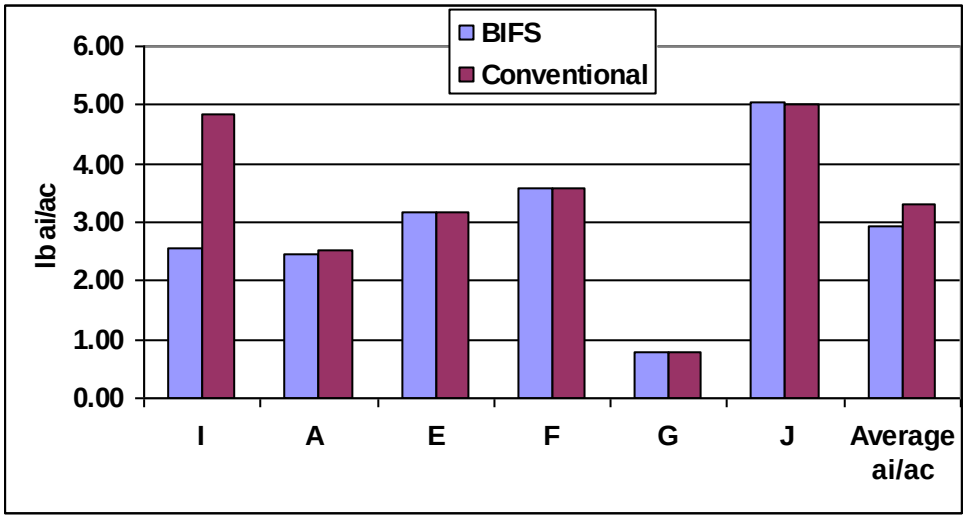
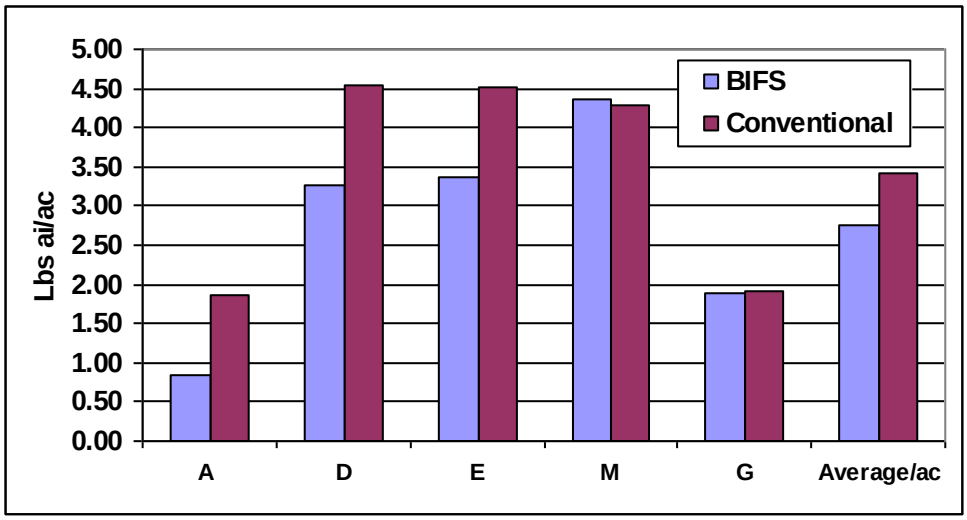


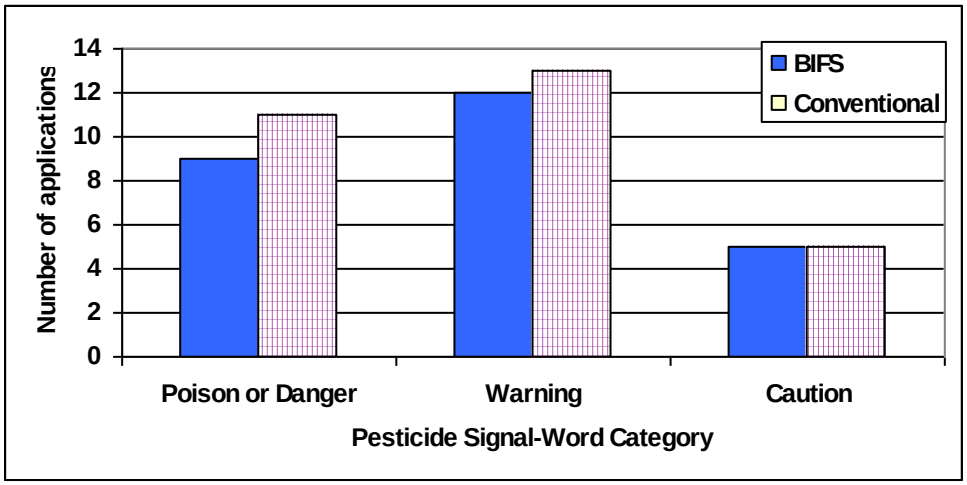
Figure 12. Pounds active ingredient of insecticides applied per acre of treated cotton sites in 1998. (From West Side BIFS Final Report, Figure 23c, page 64). Individual farms are represented as anonymous letter codes.



Reducing pesticide use alone may not have a positive impact on the environment or human health. The project provided a preliminary look at reducing risk through comparing the toxicity ratings of pesticides used. During 1997, Category I materials were used in 54 percent of applications on BIFS plots, and 52 percent of conventional

plots. In 1998, 35 percent of BIFS treatments were with Category I materials, and 38 percent for conventional plots. Figure 13 presents the toxicity categories of insecticides used by 4 growers on their BIFS and conventional plots. BIFS sites received three fewer insecticide treatments than the conventional sites. This reduction is directly attributable to the BIFS practice of not using systemic insecticides such as Thimet (phorate) and Temik (aldicarb), Category I materials (signal word "Poison and Danger").

Figure 13. Insecticide use of four BIFS participants categorized by EPA Signal Words, adapted from Figure 5 of the West Side BIFS 1998 Annual Report, page 30.



This kind of analysis should be done for all the BIFS growers on their alternative and conventional plots. And, for comparison purposes more recent insecticide/miticide or herbicide data from the California Department of Pesticide Regulation and the San Joaquin County agricultural commissioner's office should be obtained and presented for this project. The project coordinators have been informed several times that a more complete analysis of pesticide use should have been included in the Final Report.

Treflan®, a pre-emergence herbicide, was applied to nearly all tomato acreage in Fresno County in 1995. The use of Treflan® at a variable rate can reduce the use of the chemical by 40 to 60 percent. Among BIFS growers, four adopted variable rate applications and eight avoided Treflan® applications in fields with low weed pressure. From 1995 to 1997, the amount of Treflan® used in BIFS tomato fields decreased by 20 percent (West Side BIFS Final Report, pages 55-58). Reducing the rate of Treflan® did not affect weed densities until only 40 percent of the normal rate was applied, and no differences in yield were seen.

West Side BIFS farmers were asked in a survey in 1997 to characterize their highest pesticide use period from 1981 to the present. The majority responded that 1991-1996 was the highest use period for insecticides and herbicides. The majority of farmers did not use fungicides or nematicides for cotton production. The portion of the cost of cotton production due to pesticides during the period 1991-1996 was seen as increasing for both insecticides (12 farmers) but less so for herbicides (7 farmers). The mean

increase in cost was estimated to be $56/acre for insecticides and $23/acre for herbicides.

Fertilizer Use

Records of soil fertility inputs for 1997 and 1998 are provided in the West Side BIFS Final Report, Table 5, pages 46-47. Depending on the crop that was produced in a given year at a given site, most N fertilizer inputs ranged from 120 lbs/acre to 250 lbs/acre. In general, West Side BIFS participants considered the addition of organic amendments as a means for adding organic matter (carbon) to the soil during these early years of this project and did not, therefore, adjust the amounts of mineral fertilizer they applied in their BIFS fields relative to their alternative fields. This is due to concerns about possible yield reductions that may occur if nutrient inputs are reduced. However, in 1997 and 1998 six BIFS sites either reduced or eliminated a synthetic fertilizer application.

Experiences of BIFS mentor farmers Tim O'Neill and John Diener suggest that soil fertility building via organic materials generally takes more than three years. There is also experimental evidence presented and discussed during a BIFS meeting on May 1, 1998 by Dr. Tim Hartz, UC Davis, working with BIFS compost materials, that a relatively low percent of nitrogen is typically mineralized during the year following application.

Opportunities for optimizing tomato nitrogen fertilizer management and for reducing potential fertilizer leaching were also evaluated in 1998 in six BIFS project-related on-farm N-strip trials. In these studies, participating farmers evaluated the response of 0, 50, 100, 150, 200, 250 and 300 lb. per acre nitrogen applications on processing tomato yield and quality and also contributed to the development of a data base that is being developed to predict nitrogen needs based on pre-sidedress soil nitrogen pools. Preliminary data from this study (West Side BIFS 1998 Annual Report, Figure 2, page 23) present the average yield resulting from various total N inputs at six BIFS sites. It can be inferred from the fact that these fertilizer response curves are quite flat that there may be substantial means for reducing and optimizing N fertilizer inputs into West Side processing tomato production systems.

The potential for reducing mineral nitrogen fertilizer applications in cotton was evaluated in 1998 through an on-farm trial combining compost applications (10 and 20 tons/acre) with synthetic nitrogen applications. Similar yields produced between treatments indicate a potential to reduce nitrogen applications without yield loss (West Side BIFS Final Report, page 43-44).

Evaluation of the Project in Meeting Integrated Farming Systems Standards

Impact assessment survey for West Side BIFS management team

In a survey of project contributors, including UCCE, private, and public agency management team members, respondents evaluated the extent to which the Project met its five major objectives as follows, where 1 = very successfully, 2 = moderately successfully, 3 = slightly successfully and 4 = not successfully. Nine of the twelve questionnaires that were distributed have been returned and compiled.

Project Objectives	**Average Success Rating**
Exchanging information among West Side farmers, researchers and consultants	*1.33*
Demonstrating on-farm cover cropping	*1.88*
Demonstrating on-farm organic soil amendment inputs	*1.63*
Determining the degree to which IPM practices are utilized in row crops on the West Side	*2.38*
Identifying constraints preventing adoption of biologically intensive pest management practices	*2.13*

Over the three years of the study, all 16 BIFS demonstration plots received either compost or grew a cover crop, and 75 percent of BIFS sites incorporated an alternative soil management practice in each project year. For many of the plots, this was the first time that organic material was added other than from crop residue. When project participants were surveyed, a majority felt that they have increased their knowledge about soil quality management and that they intend to use this knowledge to a greater extent in the future. Seventy percent of respondents said their knowledge of functions of cover crops, selection of cover crops for particular planting windows, and management strategies for using cover crops has increased either greatly or moderately as a result of the project. Six of ten respondents indicated that their use of cover crops will increase over the next five years with four of ten indicating that their use will stay about the same. Nine of ten respondents indicated that their use of postharvest residue information will increase over the next five years when designing crop rotations.

The West Side farmers were asked to rate their overall approach to cotton IPM on a scale from 1 to 10, with 1 being conventional and 10 being biologically integrated. Overall, participants rated themselves in the middle and slightly to the conventional side of the range (mean rating = 5.04) when responding to their current approach but indicated a desire to move toward a more biologically integrated approach in the future (mean rating = 6.92). When participants rate their use of IPM in each of the four pest areas on a four point scale with 1 being no use to 4 being a lot of use, disease, insect, and weed management were all rated moderate use with means of 3.0-3.4. Highest IPM use was reported for insects and weeds; 8 and 6 farmers respectively rated their use "a lot." When asked how well informed they felt they were about IPM, all but one responded they were "fairly well informed" or "well informed." When asked if their knowledge of IPM is greater now than five years ago, all of those responding indicated

their knowledge had increased but only three reported "moderately more" to "a lot more now."

Based on 1998 survey results, the majority of farmers agreed that the information provided by field inspections and through the weekly updates in *Out Standing in Your Fields* helped them to better understand pest situations in their fields, learn new concepts, and make better decisions. The weekly data helped them develop a better understanding of the pest situation in the larger surrounding area by providing another insect population estimation in their fields, by providing additional information about natural enemies in their fields, and in providing more information about cotton growth and development.

Summary of the Annual Review

The following list summarizes conclusions from the November 1997 annual review meeting and subsequent analysis by UC SAREP of the West Side BIFS project based on their final report:

> The monitoring program for soil quality continues to generate excellent data. This program has involved collecting baseline and end-of-each-season data on key soil physical, chemical, and biological properties. Summary data for two and a half project years indicate some significant changes in biological and chemical properties in the BIFS sites as compared to conventional sites. Data of the last half of year three is still being analyzed and has not yet been presented. The soil quality monitoring data will be used to develop a Soil Quality Index that will provide growers with a tool to guide their soil management practices, and is expected to be completed in the fall of 1999.
>
> The monitoring program for pest management has increased in intensity during the three years of the project. During the first year, monitoring of pests and natural enemies was hardly done, and the project lacked a planned demonstration of an alternative pest management system. Only four of the sixteen sites were monitored and only for a limited number of plant and pest parameters. The project coordinator was told at the end of the first year that this component of the project must be improved in subsequent years. Renewed funding of this project was made contingent on development and submission of a monitoring program by March 31, 1997. In the 1997 and 1998 seasons, an intensive monitoring program for pest and beneficial species was developed on cotton, and a weekly newsletter with detailed information on organism populations and cotton growth stages was shared with BIFS growers.
>
> Trap cropping strips were used to supplement intensive in-field monitoring to aid in the control of *Lygus hesperus* in the BIFS demonstration plots. As reported by the project, the trap cropping performed only marginally and not as well as expected. However, improvements in the implementation of the trap cropping methods may lead, in part, to greater "trapping" capacity of the planted strips. The selection of a determinate variety of black-eyed peas for use as the trap crop likely limited the effectiveness of the practice. As the plants go out of flower, the trap crop becomes less attractive to pests, and consequently the target crop becomes more attractive.

Use of indeterminant cowpea varieties such as Chinese Red, Iron Clay or Red Ripper and inclusion of multiple varieties and other plant species in the trap crop would have been better approaches and are supported by the scientific literature (Flesischer, Bugg et al, Hokkanen, Stern). Farmers' experience with Lygus migration patterns, and their desire to balance pest control costs with loss in yield due to reduced cotton acreage, guided the planting of trap crops only along the upwind margin of a field. However, there is no published experimentally derived evidence that supports the planting of trap crops only along this border in the hope that the trap crop will protect an entire crop field. Problems associated with the specific methods implemented in these demonstrations affected the in-field success of trap crop use.

Baseline and end-of-season data on the previous years fertilizer and pesticide use were not presented in the 1996 annual report. The project supervisor was informed that he needed to collect and analyze these data and to submit them to UC SAREP by June 30, 1997. Some data on baseline pesticide use was submitted in the Final Report and 1997 Annual Report, and the farm plans which include pesticide and fertilizer data were submitted, however this data needed to be summarized and analyzed more completely. The project supervisor was informed that for the 1998 report this kind of data summary and analysis was required. The number of insecticide applications the BIFS growers used on their conventional and alternative plots was presented in 1997 and 1998; this is a good start. In addition, information was presented on the use of the pre-emergence herbicide Treflan®, both as total pounds used countywide, and as average pounds applied/acre for both BIFS sites and the county as a whole. However, the number of applications, acres treated, and pounds applied for all BIFS growers and for other agricultural chemicals should be presented. For example, post-emergence herbicide data was not presented. In addition, the presentation of the pesticide use data based on toxicity rating should be provided for all the BIFS growers (and not just 4) for their side-by-side plots and for all pesticides used (not just the insecticides). Comparisons of the number of applications, acres treated, and pounds applied between BIFS growers and the county averages during the three years of the project could also be presented.

In the 1998 report, interesting data was presented from a BIFS piggy-back research project on tomato yield responses to different nitrogen rates from 0 to 300 lbs. per acre. While the data is preliminary, it may demonstrate a lack of response to nitrogen at the higher rates, indicating that some other nutrient or input is limiting, and providing some data on what the optimum rate should be for tomatoes in the area.

Good data were collected on tomato, garlic and cotton yields and quality for each season, and show no difference in yields between the two farming systems.

NEXT STEPS IN THE BIFS PROGRAM

This is a relatively new program and yet interest in it has grown extensively. We received proposals requesting support for new BIFS projects that totaled $2.1 million in the 1998 funding cycle; however, only approximately $600,000 was available. To date, projects have been funded in winegrapes and cotton/vegetable crop rotations. New projects expand the commodities supported to prunes, citrus, rice, walnuts and strawberries. However, there are many other commodities and regions that have expressed interest and will be looking for support in the next few years. With the implementation of the Food Quality Protection Act of 1996, California growers of over 250 "minor" crops will need help in maintaining the economic viability of these farming systems while potentially losing various pest and soil management tools through this regulatory action. **The BIFS program should be expanded to enable support for projects in new commodities and new areas in the state so as to assist California agriculture with these challenges.**

In addition to expanding BIFS projects into new cropping systems, there is a need for BIFS projects to support innovative animal production systems – both ranching and confinement feeding operations. The latest Request for Proposals (RFP) (see Attachment 7) will enable funding of innovative animal production projects that protect the environment and human health through integrating animal production with resource conservation at the watershed level. Several of the pre-proposals submitted through this RFP on December 11, 1998 include alternative animal production systems that could qualify for funding. **The BIFS program should expand even further support of innovative animal production projects.**

The UC SAREP BIFS program can provide greater understanding and mutual respect between the agriculture industry and consumers. This will become critical with increasing land-use pressure from the expanding urban and suburban areas and with increasing pressure from the consumer for agriculture to address environmental and human health concerns. **The team-based on-farm demonstration approach and intensive monitoring and documentation of the BIFS projects can be used to educate consumers about the tough issues confronting agriculture but also highlight creative approaches that specific industries undertake.** For example, the Lodi-Woodbridge Winegrape Commission in its final year of receiving BIFS funding is looking into using an "eco label" based on the BIFS practices to obtain greater market support for their integrated farming systems efforts.

UC SAREP BIFS program will continue to work with other institutions, particularly regulatory agencies, which are interested in this approach. See Attachment 4 for an overview of the BIFS-like projects currently underway in California. The California Department of Pesticide Regulation used the BIFS program as a model for their Pest Management grants program developed in 1995 and their Pest Management Alliance program developed in 1997. The US-EPA Region 9 supported the BIFS approach from the start and is now assisting UC SAREP with using the BIFS approach to help growers prepare for the implementation of FQPA. The University of California Integrated Pest Management Project, another UC Statewide Special Project,

recently released the Request for Proposals for USDA Smith-Lever funds, which presents a changed approach to support more team-based extension efforts, emulating the BIFS program.

The BIFS program should encourage more proposal submissions from within the University of California Cooperative Extension system. Cooperative Extension is facing rapid change and is confronted with financial challenges such as tighter budgets. The BIFS program provides a competitive process by which interested UC farm advisors and specialists together with industry and regulatory partners can obtain support to expand on-farm demonstration and extension efforts. UC Cooperative Extension's participation in BIFS projects can make or break a project.

UC SAREP is uniquely positioned to continue to lead an expanding BIFS program. As a statewide program within the Division of Agriculture and Natural Resources with a mandate to support research and education in sustainable agriculture for all of California, the BIFS program fits well within the tripartite approach of sustainable agriculture, i.e. agriculture that is economically viable, environmentally sound, and socially responsible. UC SAREP has a multi-disciplinary staff that can provide biological and social science support to encourage the development, evaluation, and adoption of alternative farming and animal production systems.

ATTACHMENTS

1. Assembly Bill 3383 (AB 3383)

2. UC SAREP Request for Proposals, Spring 1998

3. Press Release on the Newly Funded BIFS Projects, August 28, 1998

4. Agricultural Partnerships in California, Sustainable Agriculture, 9:3:1-4, Broome and Liebhardt

5. Society of Environmental Chemistry and Toxicology, (SETAC) Poster Text, presented at the annual meeting in San Francisco, November 1997.

6. Assembly Bill 1998 (AB 1998) – extension of AB 3383

7. New Request for Proposals, Spring 1999