

**CONTRASTING AGRONOMIC PERFORMANCE AND PEST CONTROL  
PRACTICES BETWEEN THE SUSTAINABLE COTTON PROJECT'S  
BASIC MANAGEMENT SYSTEM AND CONVENTIONAL COTTON  
PRODUCTION PRACTICES IN CALIFORNIA**

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**Abstract**

Over the past two decades, the commercial interest in measuring “sustainability” has grown. Concepts such as “Corporate Citizenship” and “Triple Bottom Line” have lead to programs that ensure products are produced using suites of best practices that are certifiable. During this same decade, consumers have become more aware of their environmental and social responsibilities when choosing products they purchase. Cotton and cotton textiles are not isolate from this trend and a small group of California cotton growers have lead the way for over two decades. The Biological Agriculture Systems in Cotton (BASIC) is a program sponsored by the Sustainable Cotton Project. The BASIC program provided technical advice and support services to enrolled growers who desire “to develop a working knowledge of chemical reduction” which emphasize “biointensive farming practices”. A side-by-side comparison was conducted in 2008 on the California State University Fresno College Farm to evaluate the performance and costs of the two management systems. Pests were monitored weekly and while treatment decisions coincided, pest control products differed between the two systems. Beneficial insects were released in the BASIC system for additional protection. Lygus populations differed between the two systems and were a major factor in final lint yields. Total pesticides applied were similar for both systems. Insect counts, pesticide costs and lint yields from the two systems will be discussed as well as implications of increased proof of sustainability to cotton production and IPM.

**Introduction**

The incorporation of social responsibility as a corporate business practice dates back decades. The concept of the “Triple Bottom Line” (TBL) was popularized by Elkington (1997) and sought to encourage companies to incorporate social and environmental values as performance metrics alongside financial returns. TBL has been described as addressing sustainability through the consideration of the economy, environment and equity or more stated in a pithier manner, profit, planet and people. It has focused on sustainability by balancing all three bottom lines. Examples of this corporate approach are Wal-Mart and Sysco who required extensive paperwork to prove their standards of sustainability will be met before contracts are signed. Audits of performance are conducted by third parties.

Meanwhile, consumers have become more active in their consumption habits, demanding products that are provided in an environmentally and socially responsible manner. Eco-labeling has become one approach in providing easily recognizable logos which represent compliance to practice standards that are certifiable through a third party. A few examples of eco-labels include Dolphin Safe Tuna, Salmon Safe, Sustainable Forest Initiative, Healthy Grown (Wisconsin Potato Growers and University of Wisconsin), and IPM Label (Wegman & Cornell University).

The eco-label movement believes it is providing consumers with additional choices, purchasing products that are produced in a conscientious manner and that performance of these practices are audited in some manner, usually third party. In agriculture, the certification process is usually built around an environmental management system such as Farm-A-Syst or ISO-14001 process. Examples of the former include Lodi Rules® and SIP (Sustainability in Practice) in which lists of practices are provided with points associated. The more sustainable, biological and integrated the set of practices being utilized, the higher the point system.

As an example, Lodi Winegrape Commission compiled an extensive list of best practices in a comprehensive workbook (Olmart et al, 2008) in which individual growers assess and rank themselves in current practices and plan for improvements in areas of their choice. This work book combines the opportunity for teaching while allowing the

individual to contrast their state of sustainability with the wider community. However, to be certified as a *Lodi Rules* grower, an independent audit must be conducted by the third party certifier in this case Protected Harvest™.

California cotton growers and its associated textile and fashion industry have been engaged in sustainability since 1996 with the formation of the Sustainable Cotton Project (SCP). With its pest management focus, the “goal is to convert production practices from chemically-intensive to biologically based farming systems” (Grose, 2009). The production guidelines are outlined in the BASIC (Biological Agriculture Systems in Cotton) Cotton Manual (Gibbs, 2005). SCP is working with the fashion industry to create interest in sustainable fiber and create a premium for BASIC cotton. Cleaner Cotton™ is a label created to highlight the use of BASIC practices which include compliance with restricted pesticide list, enhanced biological and cultural pest management approaches, utilization of University of California Year Round IPM Program (UC IPM, 2009), and non-genetically modified cultivars. In 2008, the restricted pesticide list contains 13 pesticides mostly in the organophosphate and carbamate classes (Gibbs, personal communication). In 2006, some BASIC growers received a \$0.15/per premium for their cotton. The reliability of a premium incentive has not been firmly established. Since 2006 the availability of foreign grown organic cotton and lower fiber prices has competed with cleaner cotton. As a consequence, growers have not received premiums since 2006. Negotiations are being discussed for a \$0.10 premium for the 2009 crop (Gallegos, personal communication).

A global effort similar to SCP activities has recently developed. Better Cotton Initiative (Anon, 2009) has created Better Cotton System, a best management practice approach. Focused on developing nations, BCI seeks to improve the production practices to improve environmental and human health where cotton is grown. BCI recognizes the unique production interdependence of the cotton industry and seeks to facilitate the relationships from farm to fashion - similar to the SAFE Denim program of the American Cotton Growers.

### **Materials and Methods**

A system comparison field demonstration was established in 2008 to compare the pest control and agronomic performance between the SCP's BASIC approach to a more conventional “Standard” approach using a wider range of pest control options. The demonstration was conducted on the Fresno State College Farm located on the CSU Fresno campus, in Fresno, CA. The college manages a 1000 acre diversified farming operation for hand-on experiential learning. The farm produces all of the major crops of the central San Joaquin Valley. Half of a 20 acre field was managed using the BASIC biological intense management of less toxic chemical options plus beneficial insect releases. The other half was managed using combinations of accepted chemicals recommended from a professional Pest Control Advisor (PCA). Both BASIC and Standard treatments were based on University of California Integrated Pest Management Guidelines (UCIPM, 2008) for treatment thresholds and labeled products available for use in California. The field was planted on April 14<sup>th</sup> under “ideal” planting conditions according to a UC Five Day Planting Forecast (greater than 25 DD<sub>60</sub> forecast for the following five days, Kerby et al. 1987). Phytogen 800 Pima was the variety planted. The field was bordered on the north with alfalfa fields and on the east and west with corn and sorghum grown for silage, respectively. In some locations of the San Joaquin Valley (SJV), the 2008 season was an excessively heavy *Lygus* year (Adamczyk, 2009) but the college farm experiences similar *Lygus* pressures that were noted in other SJV counties. Alfalfa was most likely the main source of *Lygus* even though uncut strips were left at each cutting (Summers et al, 2004). The two cotton blocks were monitored weekly by the SCP field technician and by a PCA with Gar Toolelian Inc. The weekly monitoring occurred on different days and varied greatly at times between these two PCA's (Figures 1 and 2). Between June 24 and 29 *Lygus* counts varied greatly as indicated in Figures 1 and 2. This influx of *Lygus* was associated with an alfalfa cutting north of the trial field. On June 27, average *Lygus* counts varied from 8 to 50 per 50 sweeps for the two PCA's. The SCP technician's averages were only collected from the BASIC area (Fig. 1) while the PCA monitored both areas (Fig. 2). While this level of variation existed, the physical evidence of square shed was evident from consistent and at times heavy *Lygus* pressure but fruit retention was not regularly monitored or recorded. Treatment decisions were determined on *Lygus* density and did not incorporate the fruit retention and modified based on the presence of other pests (i.e. mites, foliar feeding worms, aphids and whiteflies). Pesticide treatments were applied on July 3, and July 29 for *Lygus*, worms and aphids. A September 4th application was made to reduce whiteflies and protect cotton lint. Beneficial insects were released as needed with the exception of green lacewing eggs that were spread weekly through flowering. Predatory mites *Galendromus occidentalis* were released in isolated areas that had the presence of mites. The whitefly predator *Delphastus* was dispersed as determined necessary. Yield data was collected from harvest weights of both areas. Machine harvested seedcotton was monitored using an Ag Leader (PF3000) yield

monitor. Field weights were also measured using a portable field scale. Actual weights between the field scale and yield monitor for 34 separate loads differed by 3.7 percent (Miller et al. 2009). Lint yields were calculated from roller gin turnouts following ginning.

### **Results and Discussion**

Seasonal costs of chemical treatments for the two systems were similar (Table 1). The only difference between chemical treatments in this comparison was the substitution of Provado (BASIC) with Orthene used in the Standard recommendation. All other chemical treatments were the same. The release of beneficial insects added to the seasonal total pest management costs. At the end of the season, the BASIC program including the beneficial insects for a more biointensive management program costs 17 % more than the Standard system.

The seasonal pest monitoring of Lygus, the most prevalent pest is shown in Figures 1 and 2. The difference shows the variation that can exist within a few days of sampling and different individual sampling. The influx of Lygus on June 25 coincides with an alfalfa cutting on June 23. A day or two sampling difference could miss an influx and exit of migrating Lygus. The potential range in lygus populations experienced at this field site illustrates the difficulty in managing a mobile pest like Lygus. Even though trap strips were left in the alfalfa and efforts were made to enhance beneficial insects migrating Lygus can cause varying levels of damage. The observed absence of fruiting structures within the canopy squaring during this period was evident in both management systems, although these were not quantified.

Lint yield results from this side by side demonstration are shown in Figure 3. The Standard management half produced 1071 lbs per acre compared to the BASIC half producing 977 lb per acre. This represents a 9.8% yield difference between the two systems. Bale grades and fiber quality measurements were similar for both systems (data not presented). In 2008, there was no price premium offered for the BASIC cotton.

Biointensive IPM systems encourage the establishment of a buffer strip, which in this case was used to separate the two halves. Such habitat strips incur additional costs which include not only the cost of planting and maintaining but also the loss of production. For example, in this trial 0.4 acre was committed to insect refugia that could have produced an estimated 400 pounds of lint.

### **Summary**

BASIC cotton represents cotton produced conventionally but with an emphasis on biological rather than chemical reliance. It utilizes the core of proven IPM approach while encouraging more biological diversification and a reduction in high risk pesticides. The combination of the approaches allows for new period of creative pest management research and demonstration, especially in light of newer selective and reduced risk insecticides.

In her 2009 review of sustainable cotton production, Grose concludes:

“BioIPM represents less risk of both reduced yields and increased costs to the farmer and is therefore scalable, converting more farmers and more acres faster than organic systems. BioIPM also provides a useful function as biologically intensive buffer zones between organic and conventional fields, mitigating pest migrations resulting from different cultural practices and harvesting times on neighboring conventional farms”

In this unreplicated trial, biologically intensive cotton production practices were not very different from the well managed conventionally grown cotton under the supervision of a licensed pest control advisor or an experienced farmer. Because of the restrictions placed on the choice of pesticides, only a single high risk insecticide (acephate) was eliminated and even with the augmentative releases of beneficial insects, did not produce as much lint per acre as the field using conventional IPM. Key factors important in producing this result are the newer, lower risk chemistry insecticides that have been registered within the last few years.

The BASIC, biointensive system uses a more restrictive program based on lists of high risk pesticides and non-GMO cotton. Such restrictions could limit the ability of cotton producers to employ the widest set of IPM practices to control pests. In the case of this limited comparison, the Standard IPM managed system produced 9.8 percent more lint per acre than the biointensive BASIC system at a lower cost. Since the BASIC cotton lint did not attract a

premium to off-set yield reductions and additional costs associated with biointensive cotton production, the increased cost per pound to produce lint was 14.5% higher than the Standard. Without a premium for the BASIC fiber and using the reported yields, the calculated net profit was \$134 per acre more for the Standard system compared to the BASIC system. A \$0.10 premium would have reduced the net profit difference to a \$36 per acre advantage for the Standard system.

This field demonstration has its limitations. It is important to keep in mind that because of the nature of biologically intensive IPM and its increased dependence on wider ecosystem services, a simple side-by-side demonstration may not fully capture the value, costs and contributions of one system vs. another. As researchers and entomologists, we must recognize that we are dealing with larger time and spatial scales and our experimental design should reflect those scales. Future comparisons should be studied to elucidate these important interactions and limitations to ensure greater reliability of IPM applications.

Sustainability as a component of corporate philosophy and consumer choice will only become more important in the future (Savitz, and Weber, 2006). As sustainability gains traction at the corporate and consumer levels, the increase cost to and potential risk of the farmer should be rewarded at the farm level. It is part of the triple bottom line, that farmers who strive to meet these consumer driven goals should be justly remunerated for their efforts.

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Table 1. List of chemical and costs for treatments applied 2008.

Date:	Standard	\$/A	Basic	\$/A
7/3	Orthene		Provado	
	Oberon	47.88	Oberon	97.91
7/26	PIX + Centric		PIX + Carbine	
	Steward	87.80	Intrepid	43.25
	Beneficial insect releases:	0		25.00
9/4*	Oberon		same treatment applied	
	Baythroid			
	Pasada	<u>42.77</u>		<u>42.77</u>
<b>Totals:</b>		<b>\$178.46</b>		<b>\$208.93</b>

\*9/4 application was applied to both areas to control aphids and whiteflies.

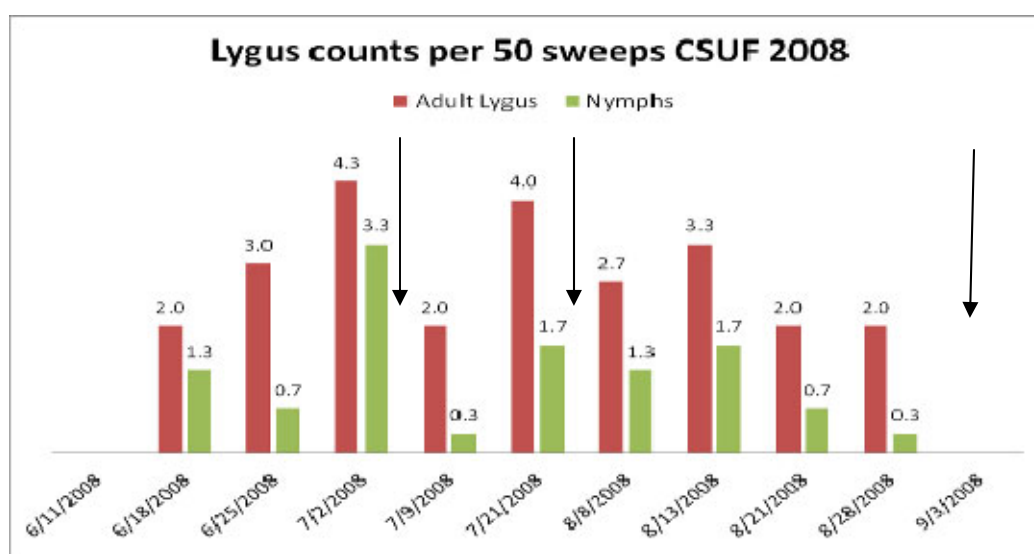


Figure 1. Sweep counts of adult and nymphal Lygus from BASIC managed field (counts per 50 sweeps). Arrows indicate pest control applications on July 3 and 29, 2008. The Sept. application was for whiteflies.

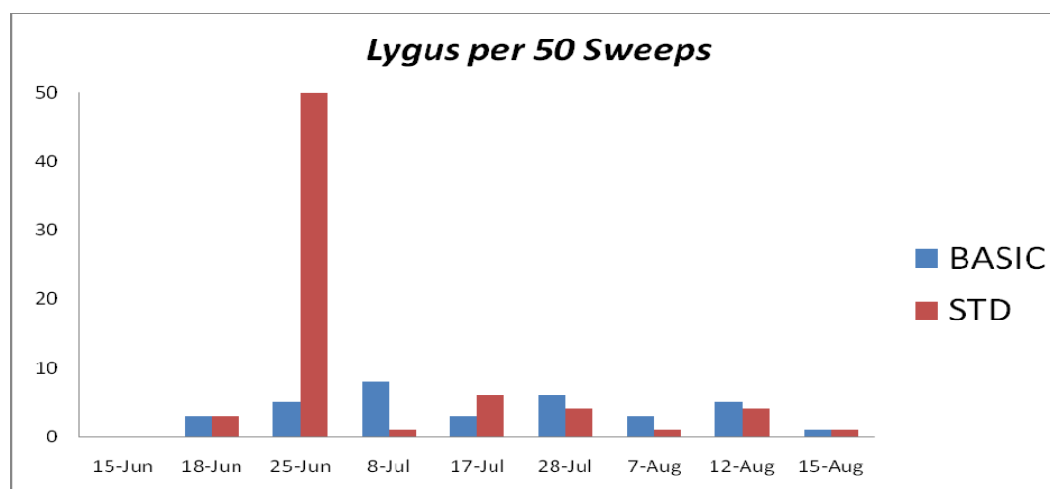


Figure 2. Sweep counts of Lygus from Standard and BASIC halves showing different monitoring results for the June 25<sup>th</sup> sampling date.

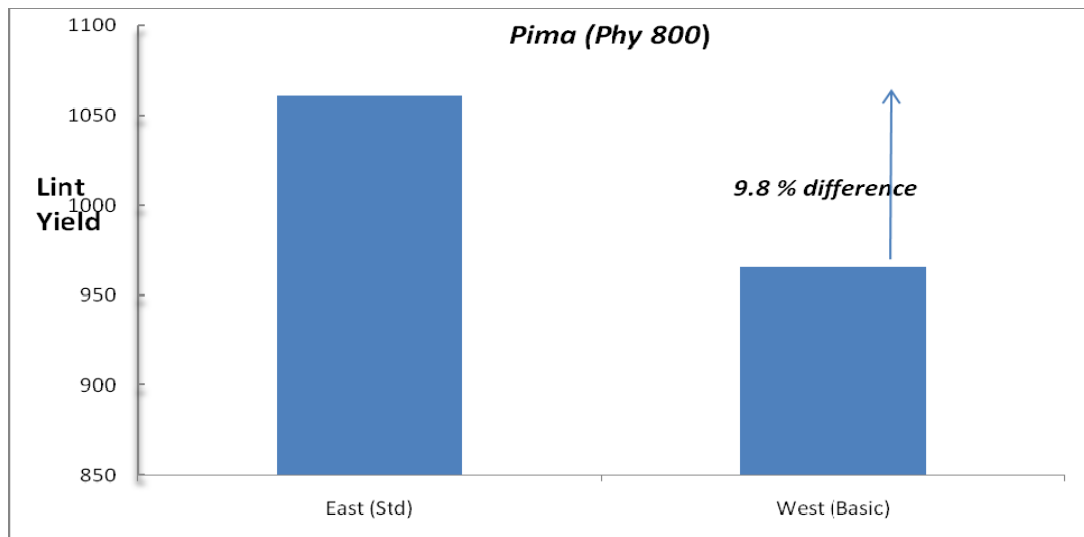


Figure 3. Lint yields from field comparisons of Standard (East) and BASIC (West) areas (2008).