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COTTON IPM IN CALIFORNIA: WHAT DOES IT MEAN TO USE IPM? *Peter B. Goodell, UC Kearney Agricultural Center*

Presentation to the Field to Fashion Cotton Conference February 25-26, 1999, San Francisco, California.

The annual damage caused by cotton insect pests in the San Joaquin Valley (SJV) of California is estimated at $47,013,275 (Williams 1994-98). Lygus bugs, spider mites, and aphids cause the bulk of the damage. Control costs have risen at an average rate of $15/ac/year while yield has been reduced due to weather and insect pressure.

IPM seeks a balance between the prevention of yield loss and excessive insecticide spraying. IPM can be described as a continuum of practices stretching from complete reliance on insecticide controls to a high reliance on biological control. Practices associated with highly integrated, bio-intensive IPM include:

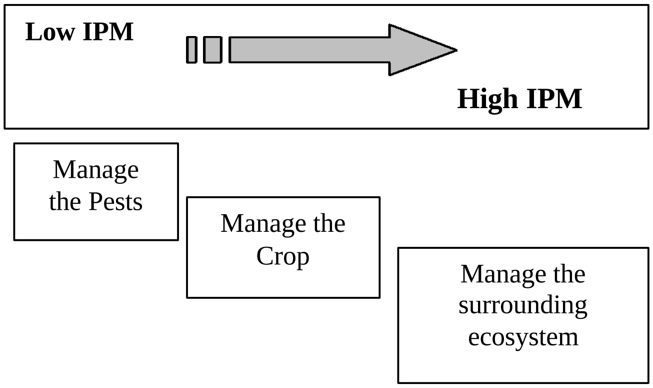
- Increased reliance on indigenous natural enemies
- Availability of reduced risk, narrow-spectrum insecticides
- Availability of biological control agents for management of key pests
- Proactive prevention strategies to avoid or dilute the pest problem

This presentation seeks to answer the questions: what constitutes a reasonable suite of IPM practices and where on the continuum does cotton IPM lie? The discussion will be developed around the production system of the West Side SJV that was part of a three year study supported by UC-SAREP's Biologically Integrated Farming System program (BIFS).

The West Side stretches from Merced County in the north through Fresno, Kings, and Kern Counties, roughly along the Interstate 5 corridor. This area is extremely productive and characterized by intensive production schedules with production units usually 160-acre in size. It has a diverse cropping pattern including cotton, melons, seed alfalfa, alfalfa hay, onions, garlic, safflower, grain, almonds, pistachios, and vines.

The IPM Continuum

The concept of the IPM continuum as presented by Benbrook (1996) suggests increased complexity as an IPM program moves from being chemically based to biologically based. The complexity also can be described in terms of the scope of management:



Managing the **pest** is the most basic function of IPM. It requires knowledge of the pest, its population density, and its potential impact on yield. As experience and knowledge increase, interactions among multiple pests are considered simultaneously. Examples of practices include:

- Frequent inspections of the field for insects and natural enemies
- Treating only when pest population threatens yields
- Preserving natural enemies; avoiding broad-spectrum insecticides
- Managing the pest population to maintain insecticide susceptibility

IPM recognizes that **crop management** is the basis for pest management. The objective is to favor the plant and provide it the advantage of strong growth and development. General approaches include:

- Choose the plant variety best suited for the conditions
- Utilize host plant resistance to nematodes and vascular diseases
- Plant early into conditions conducive for rapid plant emergence
- Manage the crop for the minimum season
- Terminate the crop as soon as possible

Managing the **surrounding ecosystem** is the most complex and long-term aspect of cotton IPM. It requires the development of a community that recognizes the need for cooperative management within a region. Key to the success is knowledge about ecological relationships of pests, natural enemies, and their habitats within the community and across time. For example, any success in Lygus management must manage the sources where this pest develops and sinks to which it migrates (Stern et al., 1967). Several key practices might include:

- Coordinated management efforts such as removal of hosts (e.g volunteer plants supporting whiteflies)
- Controlling pests on the borders of problem areas, including regional mating disruption strategies
- Developing regional management strategies to mitigate pest migrations such as providing alternative, preferred habitats
- Developing biological control programs aimed at off-site sources where pests develop prior to migration to cotton.

Are West Side Farmers using IPM?

In 1996, the Federal government committed 75% of the nation's agricultural acres to be using IPM by the year 2000. This goal will be evaluated using a generic list of practices referred to as PAMS (Prevention, Avoidance, Monitoring and Suppression) (USDA Special Circular, 1998). By definition, if practices from three of the four groups are utilized, then the farm is considered an IPM farm. This base standard of IPM practices can serve as the definition for Low IPM. The following list provides generic practices with the specific activities practiced by West Side cotton farmers and PCAs.

Prevention

1. Plow down to manage pests (pink bollworm plow down)
2. Use irrigation scheduling (schedule last cotton irrigation to minimize excessive late season growth)

Avoidance:

3. Adjust planting dates to manage pests (5-day planting forecast; 90 day host free period for pink bollworm)

Monitoring:

4. Scout for pests (twice weekly by PCA)
5. Keep written records (formal written weekly report)
6. Pheromones for insect monitoring (pink bollworm trapping program)

Suppression:

7. Seed treatments (seedling disease protection)
8. Use action thresholds for control decisions (UC IPM Guidelines for Lygus, aphids, mites)
9. Use ground cover or physical barrier (bean strips to catch Lygus)
10. Adjust plant density to control pests (limit density to less than 55,000 plants/ac)
11. Alternate pesticides to prevent resistance from building up (1998 Resistance Management Guidelines)

These eleven practices were integrated into the West Side cotton farming practices in 1998 and most had been in use for many years (Mitchell and Goodell, 1998) (Table 1). National Agricultural Statistics Service lists

20 tactics under the 4 PAMS heading. When an area has utilized any of the practices from three out of four categories, it is considered to have an IPM base. West Side farmers used 11 practices from all four categories in 1998 and therefore are practicing IPM at a higher than base level.

This practice list (Table 1) can be placed into complexity categories as described previously. The practices consist of five pest practices, four crop practices, and four ecosystem practices. If the position on an IPM continuum is judged by the number of practices being used from the all levels of complexity, current IPM practices in West Side cotton production should place it in at least the mid-range on a continuum.

Is IPM resulting in less pesticide use?

One measure of pest management impacts is to examine pesticide use patterns. California has a 100% reporting system with data readily available, though not very timely. The most recent "official" data set is 1995. Using 1995 data from the Department of Pesticide Regulation as a baseline of comparison, 1997 and 1998 use from the West Side BIFS Demonstration farms are contrasted (Figure 1).

These figures are based only on insecticide (and miticide) use, not total pesticide. These do not include adjuvants such as stickers or spreaders that may have been used during the treatment. These data show a 17% decrease in insecticide use in 1998 compared to 1995 and follow the insecticide use patterns for CA (Figure 2).

Insecticide use as an indicator of the progress in IPM programs should be considered with caution. As an indicator it is open to interpretation by numerous factors including:

- The type of insecticide including selectivity and risk factors to the environment and human health
- The size (amount) of the dose per acre used
- What types of pesticides are included in the comparison
- The average use in the state which indicates the overall pest pressure for that year
- Specific environmental and ecological conditions of the area being reviewed and compared to averages and/or other years and locations.

Conclusions

Integration of IPM practices should result in a reduction of insecticides. This is especially true in systems in which little or no information has been collected on the population density of pests, natural enemies, and crop development. In mature IPM systems such as those found in California cotton, increasing complexity is required to push the IPM practices toward more biological integration. However, agricultural ecosystems are dynamic and under constant pressure to change. Conditions that cause an insect to become a pest (Clark, 1979) include the introduction of new pests (silverleaf whitefly), changes in cultural practices (i.e. shifts in chemical usage; shifts in cropping patterns) or changes in the insect (reduced susceptibility to insecticides; changes in feeding patterns). Such changes can result in pest outbreaks and resulting insecticide increases.

The keys to IPM are knowing if treatment is needed, when to apply, what the side-effects of the control measure might be, selecting the least disruptive materials, and holding off treatments to allow natural enemies or cultural control measures to do their work. The general approaches are then modified to fit the site-specific requirements of the cotton production system being managed.

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Table 1. List of practices developed by West Side BIFS participants that increase biological integration in cotton IPM and the number of side-by-side sites that incorporated the practice, (n=10).

Suggested Practice	**Now Using**	**No. Years in Use**	**Complexity Category**
Plant cotton according to soil temperature and five-day forecast	10	9.3	Crop
Planting at densities no more than 45,000 – 55,000 plants/ac[1]			Crop
Use of resistant varieties where appropriate and available[1]			Crop
Twice weekly inspections for insects and mites	10	6.4	Pest
Pest density to reach action thresholds before pest control	9	9.7	Pest
Follow 1998 Insecticide Resistance Management Guidelines	9	6.1	Pest
Monitor insecticide resistance with bioassays	7	11.6	Pest
Use of cowpea buffer strip on upwind edge of field	5	1.8	Ecosystem
Release of natural enemies	3	1.7	Ecosystem
Conservation of natural enemies	10	11.3	Pest
Consider the condition of neighboring crops for managing pests	9	9.5	Ecosystem
Crop termination as early as dictated by plant monitoring indices	9	8	Crop
Attend UCCE summer production meetings and BIFS field days	10	8.2	----
Provide alternative habitat for natural enemies	2	8	Ecosystem

[1] Farmers not specifically asked this question. Data collected from farm profile reports.

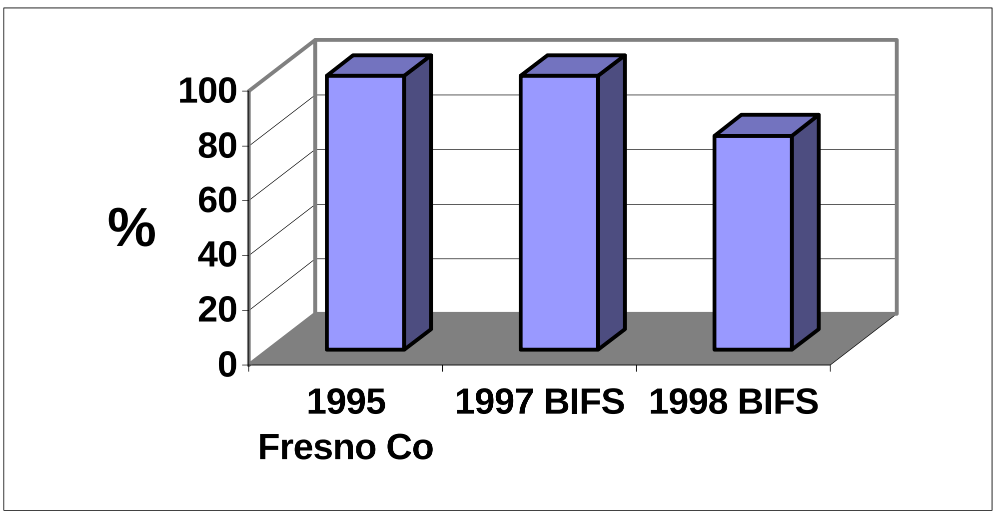

Figure 1. Insecticide use by Fresno Co. West Side cotton farmers. Percent ai/ac compared to 1995 Fresno Co. average.

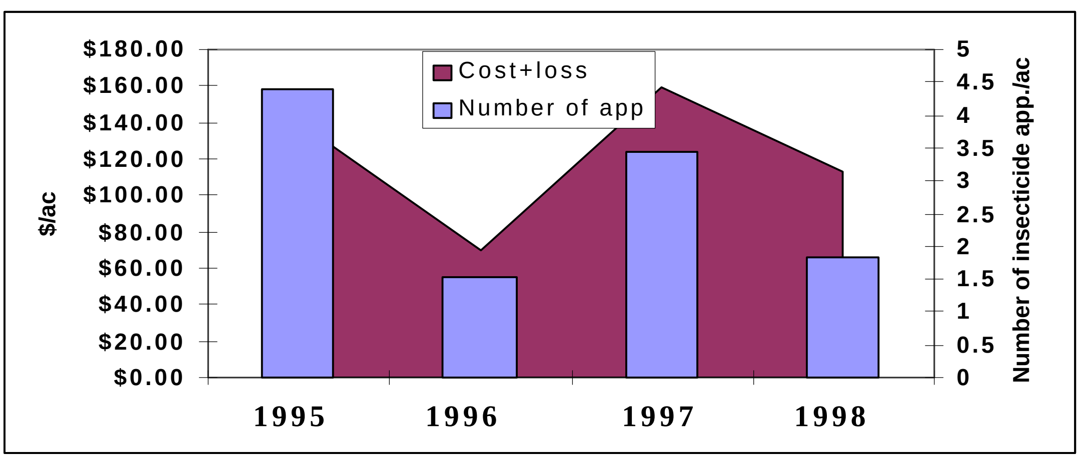

Figure 2. Estimated loss and number of insecticide applications to CA cotton.