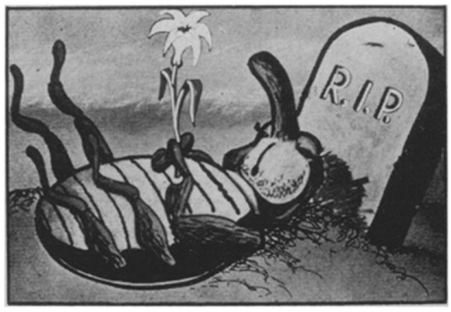
PROTECTING KING COTTON

Integrated pest management promises to control the most economically devastating crop insects in the world — those that feast on cotton — and in the process to reduce the heaviest chemical insecticide usage on an agricultural crop in the United States

BY JOAN AREHART-TREICHEL



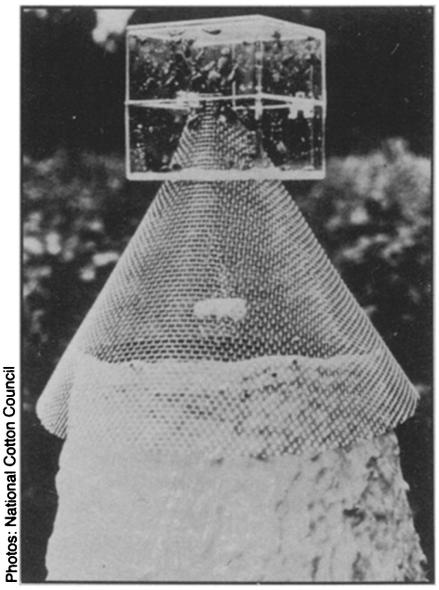
Throughout the 19th century, the southern United States was knee-deep in lush, creamy cotton — as much as 40 million acres at one time. In fact, the silky strands of cotton were probably more responsible for the lifestyle of the 19th century South than any other factor. They were the fabric from which plantation aristocracy and slavery alike were woven, the agroeconomics underlying both *Gone With the Wind* and *Roots*. Southern cotton was eagerly bought by northern and world markets; it was the nation's leading export commodity. In the South, cotton was "king."

Then, shortly after 1900, boll weevils made their way from Mexico into the southern states and devoured acre after acre of cotton. The plunder went on year after year and dealt southern cotton and the culture so heavily dependent on it a catastrophic blow. Tens of thousands of foreclosures and bankruptcies resulted. In 1904, the boll weevil cost Texas cotton growers $10 million, and Texas legislators offered a reward of $50,000 for a remedy that would dispose of the pest. By 1930, boll weevils had reduced the South's cotton crops by 30 percent.

During the 1940s, however, it looked as if "King Cotton" might make a comeback from the long insect siege, thanks to the arrival of organochlorine and organophosphate pesticides. As the 1950s and 1960s came and went, though, these chemicals turned out to be stopgap helps at best. The boll weevil and some other cotton insect pests built resistance to some of the pesticides, or as the chemicals wiped out primary cotton pests, secondary pests moved in. What's more, as insecticides became increasingly ineffective, cotton farmers had to use more of them to get results — an expensive proposition. And with increasing concern about the effects of pesticides on the environment, the Environmental Protection Agency banned some of the pesticides upon which cotton farmers depended most heavily.

Is there any direction in which the cotton farmer can turn now for protection against the constant onslaught of the boll weevil and other pests? And will it ever be possible to reinstate "King Cotton" (currently about 13 million acres) to its glorious 19th century production levels (40 million acres)? If so, the results would benefit not only the cotton industry but consumers and the woeful U.S. trade deficit as well. (Cotton is a valuable export, accounting for $1.7 billion in 1978, or 6.2 percent of foreign exchange earnings from agriculture.) The answers may well have emerged during the 1970s, thanks to the ingenuity and hard work of university, government and industry scientists who have contributed to development of a system called Integrated Pest Management. IPM consists of deploying a slew of innovative weapons alongside conventional insecticides in hopes that cotton farmers will eventually have to depend less and less on the latter for insect control. This tack is all the more daring when one realizes that cotton insect pests are the most economically devastating crop insect pests in the world, and that cotton farmers have thus depended in recent years more on insecticides than have any other kinds of farmers.

Nonetheless, IPM is proving so successful that today more than one-third of all the cotton acreage in the 14 major cotton producing states is protected by it. And while the need for insecticides has increased on a few cotton farms as a result of IPM, the overall requirement for pesticides on U.S. cotton crops has declined because of it. Thus IPM enthusiasts include not only the scientists who have engineered it but also members of the cotton industry — cotton farmers, cotton ginners, cotton seed processors, cotton warehousers, cotton merchants, cotton cooperatives and textile manufacturers. In fact, all of these various cotton industry interests, which are represented by the National Cotton Council, adopted "unanimous support for IPM" in February 1978.



Photos: National Cotton Council

Pheromone traps are one of IPM's successful methods of combatting cotton pests.

To better appreciate why both scientists and cotton industry members are bullish about IPM, let's look at some of the IPM approaches being taken and the progress being made in reducing the need for insecticides in cotton production.

"From what you read, you'd think that Texas cotton is ankle-deep in insecticides," declares W. L. Sterling of Texas A & M University in College Station, Texas. "Not true!" he counters. Texas, in fact, seems to be the most advanced of all the cotton-belt states in the scope of its IPM efforts. Approximately 1,700,000 acres of Texas cotton are protected by IPM, reports James M. Brown, manager of production technology for the National Cotton Council in Memphis, Tenn.

Texas's major attack on cotton pests, Sterling explains, consists of using early maturing varieties of cotton that are vulnerable to insects for the shortest time span possible. These varieties are working so well that they are reducing cotton farmers' dependence on insecticides as well as increasing cotton yields. Still another strategy that is lessening cotton farmers' reliance on chemicals is that of using microbials alone or with limited amounts of insecticides. Microbials are commercially harvested or processed natural pathogens of harmful pests — usually bacteria or viruses (SN: 1/7/78, p. 10). Says Sterling, "Some of us think these have great potential in Texas." Naturally existing predators of cotton insect pests offer a third approach to reducing reliance on insecticides. Outstanding predators include ants, spiders, big-eyed bugs, insidious flower bugs, assassin bugs and nabid bugs. Now that these predators have been identified, Sterling and colleagues make counts of them in the field, and if sufficient numbers are present, there is no need for insecticides.

Thanks to these various approaches, Sterling explains, "Three-fourths of all cotton fields in Texas received no insecticides

during 1977. We have gotten accepted yields of cotton without them. We were told this was impossible. We expect to eliminate dependence on insecticides even more as we computer model our insect populations and advise farmers what to do about them."

Good IPM results are also being achieved on Arkansas cotton, reports Mark Mayse of the University of Arkansas at Fayetteville. Arkansas scientists and farmers used a viral microbial plus limited insecticide and natural controls of the bollworm (a major cotton pest) as much as possible on 16,000 acres of cotton during 1976 and 1977. As a result of this IPM test, dependence on chemical insecticides dropped by 80 percent without harming cotton production. By 1978 IPM efforts were extended from 16,000 acres to 76,800 acres.

How about IPM endeavors on Mississippi cotton? Mississippi is the heart of the old cotton belt, and Mississippi cotton is especially vulnerable to insects because of lush growth in the fertile Mississippi River Delta soil and because of high rainfall. James W. Smith and other scientists at the U.S. Department of Agriculture's Bioenvironmental Insect Control Laboratory in Stoneville, Miss., have shown that

Boll weevils, the worst of all cotton pests, feed on cotton both as larvae (above) and as adults.

spiders, one of the natural predators of cotton pests, can be used to help keep the pests down during the summer. Then microbials or insecticides can be applied during late summer to provide subsequent protection. This way reliance on chemicals is being reduced. Late last year, Clyde Sartor of Vicksburg, Miss., and other researchers at Abbott Laboratories tested their brand of the most widely used bacterial microbial now available — *Bacillus thuringiensis* — on 25,000 acres of Mississippi cotton and showed that it could suppress cotton worm pests effectively. Both farmers and consultants were pleased with the results.

IPM can likewise claim advances with Georgia cotton. Georgia scientists and commercial cotton breeders are breeding early maturing varieties of cotton, just as researchers in Texas and elsewhere are, in order to make cotton vulnerable to insects for the shortest time span possible. These varieties have reduced reliance on insecticides and should reduce them even further in the future, predicts Gary A. Herzog of the University of Georgia at Tifton. (These varieties, like the Texas ones, also produce more cotton than do conventional types.) Georgia investigators are likewise lowering farmers' reliance on conventional insecticides by developing better crop management systems. Among these management techniques are proper use of herbicides for weed control, optimum fertilization levels, improved timing and use of selective pesticides for insect control. All of these management tools reduce the risk of serious insect attack.

In the Carolinas and Virginia a three-year trial by federal and state governments and cotton growers got underway in 1978 to determine whether the boll weevil can be totally eradicated from cotton in these states by using insecticides, the boll weevil pheromone, sterile weevil releases and some other techniques. This was an ambitious undertaking, to say the least, since chemicals are the only proven means of weevil control and since there are no significant natural biological predators for the weevil. Nonetheless, the first-year results look promising, Brown reports. "If scientists can eradicate the boll weevil," he asserts, "it will result in a significant reduction in the use of pesticides on cotton. Such a reduction, in turn, should also lead to the survival of more insects which kill secondary cotton pests and which are often inadvertently destroyed with the application of insecticides."

IPM has even reached the cotton fields of Arizona and southern California, where insect problems are somewhat different from those of the South and do not include the boll weevil. According to Leon Moore of the University of Arizona at Tucson, IPM there includes scouting cotton fields for insect pests, then deciding whether to use natural predators, microbials or insecticides on them, depending on which pests are present and in what quantities. Arizona and California scientists are also breeding cotton plants that are resistant to pests (two are already commercially available from private breeders) and are developing the use of sex pheromones to trap or confuse the pests. Cotton farmers in these states are pleased with the results of the efforts, Moore says, which have reduced reliance on insecticides.

Some tough challenges still face IPM, of course, before it dramatically lowers all cotton farmers' dependence on insecticides and perhaps even increases cotton production. For instance, cotton farmers need to be alerted to the necessity of switching from total reliance on chemicals to IPM. They must be made cognizant of the findings of IPM scientists that indiscriminate application of chemicals may be actually worse than the failure to use chemicals, because it tends to kill off natural enemies of cotton insect pests. Farmers must also come to realize that while microbials do not work as rapidly as insecticides do, the former can achieve comparable results in the long run. However, cotton farmers, more than most other kinds of farmers, are fast appreciating the value of IPM and moving in that direction.

As successful as IPM tactics have been, researchers realize they still have to come up with better IPM ploys against cotton pests than those that now exist. According to Frank Hist of Sandoz Inc. in Athens, Ga., for instance, researchers must learn why microbials are effective in some cotton fields but not in others and exactly what they can do for IPM programs. The full potential of natural predators in IPM also needs further exploration, Smith contends. "We don't want to oversell microbials but use natural controls as well," he asserts. And from Herzog's vantage, "We must analyze pest cycles more carefully to look for weak links in insect populations."

Nonetheless, scientists evolving IPM are confident that they can meet these challenges. Attests Moore: "It takes a long time to turn around an area where chemical insecticides have been heavily used for many years. The natural balance between beneficial insects and pests has been too loused up. But we can make progress if we have farmers who want to help." How about the National Cotton Council? It too is confident that scientists can cope with these problems. In fact, it has resolved to support scientists in their efforts to devise even more effective weapons. □