THE 1995 INSECT YEAR

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Abstract

The 1995 insect year was easily the most damaging since 1977. Using information from the annual Beltwide Cotton Insect Losses Survey, 1995 losses were compared with the average insect losses and control costs for all insects on beltwide basis during the previous six year period, 89-94. Percent yield loss was 6.83 vs 11.08% for 1995 and bales lost were 1.08 million vs 2.275 million in 1995. Six year average cost of control per acre was $39.44 vs $57.93 for 1995. This resulted in total control costs of $468 million vs $889 million for 1995. When total lost yield and control costs are combined, the estimate for 89-94 was $857 million compared to a whopping $1.68 billion for 1995 - more than twice as much. Based on estimates of acres treated, almost all pests were heavier than normal and more widespread. A series of mild winters was experienced across much of the cotton belt. In general, insect pests occurred earlier and in higher numbers than expected. As a result, the natural enemy complex really took a beating as a result of early season treatments made for thrips, aphids, over-wintered boll weevils, June populations of tobacco budworms, lygus and plant bugs, fleahoppers, and weevil eradication treatments.

Introduction

The 1995 insect year was easily the most damaging since 1977. Obviously, we could devote days to discussions of the situation. This presentation is therefore designed to give a quick, broadbrush overview of the unusually heavy insect situation experienced across the Cotton Belt. A summary of extent of damage in terms of crop losses and control costs, rather generalized reviews of major pests, and a brief look at upcoming season will be presented.

Extent of Insect Damage

Each year since 1979, the Insect Research and Control Conference conducts a survey to estimate cotton's losses to insect pests. The 1995 survey, which will be officially adopted by the conferees later this week, gives a sobering picture of the extent of widespread insect problems encountered (Williams, 1996).

In order to put 1995 in perspective, I compared 1995 with the average insect losses and control costs for all insects on beltwide basis during the previous six year period, 89-94. (Head, 1990, 91, 92, 93, Williams, 1994, 95). These comparisons are shown in Table 1. Note that percent yield loss was 6.83 vs 11.08% for 1995 and bales lost were 1.08 million vs 2.275 million. Please be aware that there is an acreage difference, 11.9 vs 15.9 for 1995. Six year average costs of control per acre was $39.44 vs $57.93 for 1995. This resulted in total control costs of $468 million vs $889 million for 1995. When total lost yield and control costs are combined, the estimate for 89-94 was $857 million compared to a whopping $1.68 billion for 1995 - more than twice as much. In addition to the acreage difference, these figures reflect several things, including higher cost of control products, higher insect populations, wider distribution of pests, new pests like aphids, silverleaf whitefly, and beet armyworm, and finally, decreased levels of control.

When we examine some of the details, we see that, based on acres treated, almost all pests were heavier than normal and more widespread (Table 2). For example, the boll weevil was treated on an estimated 7 million acres compared to 4.4 million acres. The bollworm and tobacco budworm complex caused more acres to be treated, 6.5 vs 9.3 million acres in 1995. Plant bugs, including *Lygus hesperus* in the west, were treated on 4.5 million acres - more than ever before! For aphids, the 5.2 million acres treated vs 3.5 during the 89-94 period was exceeded only in 1991, when 5.6 million acres were treated. The beet armyworm was a significant contributor to higher losses, more acres treated and increased costs of control. During 89-94, beets were treated on an average of 700,000 acres but in 1995, beet armyworm was treated on 2.6 million acres.

Figures for bales lost, shown in Table 3, reflect higher losses and more infested acres. The tobacco budworm caused enormous damage accounting for 785,000 bales lost for 1995 compared to 290,000 for 89-94. Beet armyworm caused an estimated 28,000 bale loss annually over the six year comparative period but in 1995 caused more than 12 times that amount -343,000 bales.

Average beltwide per acre control costs from 1985 to 1995 are shown on Figure 1. Control costs have increased from $24.78 to $57.93 over that period.

Weather and Early Season Conditions

When we attempt to understand what happened in 1995, it may help to recognize that insects are cold-blooded creatures which are greatly influenced by their environment. The insect environment may be molded by Mother Nature or altered in many ways by our farming activities. We have had a series of mild winters across much of the cotton belt. The weather service recorded the 1994-95 winter as the second mildest on record. Because of these mild winters, insects in general have been able to survive the winter far north of their normal range and in larger numbers. For example, the beet armyworm is

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benefited by a mild winter because it is a migratory insect which does not have a diapausing stage to enable it to withstand winter conditions. It usually overwinters in Central Florida and South Texas and Northern Mexico. And, as we well know, the boll weevil adult is the diapausing stage which provides this insect with a winter survival mechanism. Even so, only 3 to 7% of the weevils will survive an average winter. Each year, entomologists in the Texas Plains monitor overwinter survival of the weevil. Such studies confirm that last winter, greater than 50% survival in the best overwinter sites were common and that over the last five years, the average in the region is in the range of 22%.

Damaging insect populations were heavy early in the season and as a result, producers had little choice but to protect the cotton crop with multiple applications of products either alone or in mixtures early in the season prior to the normal worm season. Boll weevil eradication faced the same situation. In general, the natural enemy complex really took a beating as a result of early season treatments made for thrips, aphids, overwintered boll weevils, June populations of tobacco budworms, lygus and plant bugs, fleahoppers, and weevil eradication treatments.

Overview of Major Insect Pests

Boll Weevils

Mild winters have allowed the boll weevil to significantly expand its range on the Texas High Plains and in New Mexico. Estimates show that the boll weevil now infests 75% of cotton acres on the High Plains and 55% of New Mexico cotton acreage. With high overwintering populations, one or two pinhead square treatments with common organophosphate and carbamate boll weevil control products were applied. Beltwide, boll weevils were treated on more than 7 million acres in 1995 and caused estimated loss of 451,000 bales.

High weevil numbers caused boll weevil eradication programs also to make more treatments than anticipated and resulted in significant cost overruns in eradication programs.

The role of weevil eradication treatments in 1995 insect outbreaks has recently been hotly debated and it will continue to be debated for a long time. Regardless of the role eradication played, the take home lesson is that our industry must do whatever possible to eliminate the possibility of this happening again either in existing or future program expansions. In fact, grower leadership, the technical committee and program management in Texas have developed and adopted changes designed to minimize impact on natural enemies early in the season. The southeast program in Alabama has similar adjustments under consideration.

The eradicated southeastern states of Virginia, North Carolina, South Carolina and Georgia each experienced reintroductions of boll weevils this year. A proven pheromone trapping surveillance program is in place to detect such reintroductions. Most of the weevil captures could be traced to trappers simply not doing their jobs, however, movement of harvesting equipment was also thought to be a contributing factor. Producers in the eradicated states should be especially mindful of the continuing threat of weevil reintroductions and should never allow harvesting equipment to come onto their property without state certification to show that it has been cleaned.

Beet Armyworm

Beet armyworm infested 6.8 million acres (43%) and treatments were applied on 2.6 million acres (16.4%) -- three times more than the 89-94 average treated acres (Table 4). Beet armyworm was a serious problem in several areas inside and outside boll weevil eradication programs and even in areas in southwest Georgia, Florida's panhandle and South Alabama where the eradication program is complete. Some locations in the eradicated area had extremely high moth counts in traps but failed to develop damaging field populations. In late August, armyworm populations of 50 to 200 worms per three feet of row were reported in south Alabama and the Florida panhandle. Generally, the pattern developed that beet armyworm problems occurred whenever applications were applied for other pests. Pockets of treatable infestations occurred in North and South Carolina and economic infestations were generally present and locally heavy in Alabama, Mississippi, Louisiana, Arkansas, Tennessee and up into Missouri.

We have all heard about the beet armyworm in Texas. State survey results show that 2.9 (56%) of the 5.2 million acres in Texas was infested. Treatments were applied on 1.17 million acres (22%).

The LRGV, in the first year of boll weevil eradication, started the season with 54 days without rainfall. Then during April and May, early and heavy aphid populations required multiple applications of aphicides often applied in combinations. The Valley experienced the devastating populations of beet armyworm beginning Memorial Day weekend. Scattered infestations occurred in the Coastal Bend and caused 25% of its acreage to be treated. The Southern Rolling Plains sustained severe beet armyworm damage. Natural enemy populations, already reduced by 2 applications for aphids and boll weevil eradication treatments on less than half of the acreage, were simply overwhelmed by high beet armyworm populations.

Table 3 shows estimates of the beet armyworm damage in 1995 using the previous most damaging year - 1993. Beet armyworm infested 43% of the US cotton acreage - 6.8 million acres in 1995. This is an increase of 3.4 million over the 3.4 million acres in 1993. Growers treated 2.6 million of the infested acres compared to 1.7 in 1993. Bales lost to beet armyworm was estimated to be 343,000 in 1995 - 3.5 times higher than the previous high of 94,521 bales in 1993.

Dr. Ron Smith at Auburn University has many times referred to the beet armyworm as a changing pest. It is becoming a primary pest rather than a secondary, sporadic one. It seems to have a stronger preference for cotton as a host. Its distribution range is ever increasing and it is being detected in cotton fields much earlier in the season. There is increasing suspicion that beets will be back in the area year after year and that winter survival may be better than we think. The sporadic nature of this insect has made it difficult to study, so there are many things that we do not know about beet armyworm. However, based on many observations over the years, there are several keys to outbreaks of beet armyworm worth noting. Beets seem to be heavier following mild winters or planting delays, when crop maturity has been delayed. Early insecticide, especially organophosphates, eliminate or reduce natural enemies. Prolonged hot and dry weather is usually associated, especially when beets were present early in the season. Sandy soils, with skippy stands, or skip rows or open canopied cotton is closely associated with beet armyworm outbreaks. Pigweeds are a preferred host and beets usually will move into nearby cotton.

Tobacco Budworm

This year has been an especially bad tobacco budworm year. Figure 2 shows data from LSU's Dr. Jerry Graves of pyrethroid resistance monitoring in Louisiana since 1987. The test measures resistance of the adult moth to a 10 microgram dose of cypermethrin in a glass vial. These data show that for the last few years, levels of resistance in tobacco budworm to synthetic pyrethroids has been high enough that, given heavy populations of budworm, control would be unsatisfactory. During 1995, high populations and control breakdowns were observed over and over in the field. Most controls applied at high rates and in combinations only gave 55 to 60% under best conditions. There is a huge difference between 60% control when there are 3 larvae per foot of row compared to 60% control with population densities of 3 larvae per plant!

Table 5 shows more data from Dr. Graves showing that Alabama budworms are resistant to all three classes of chemical insecticides. The LSU lab data is from testing on a susceptible population. In Alabama and Mississippi, June populations of moths, eggs and larvae have been higher than ever observed and were in fields earlier. Moth flights, normally a week in duration, stretched up to 21 days. July larval numbers of 3-7 per plant were common and moth flights again extended 15-20 days with moths continually laying eggs. Populations were so high that control levels of only 50-65% still left one or two worms on the plant to cycle through to the next generation. Areas affected were scattered locations in south Georgia and Florida, most of Alabama, Mississippi in the east and central hill sections, and southwest Tennessee counties bordering Mississippi. Abandonment was high in Mississippi, central Alabama, and some southeast Tennessee counties. Those protecting the crop resulted in extremely high control costs and low yield. Mississippi's Delta region, Louisiana, Arkansas and Missouri experienced more normal infestation levels although control levels were also unsatis-factory.

Aphids

Cotton aphids were extremely early and heavy in most states. Estimates show that in 1995, treatments were applied for aphids on 5.25 million acres and infested 13.8 of the 15.7 million harvested acres. Only in 1991 were more acres treated for aphids with 5.6 million acres treated.

EPA responded to the industry's request and worked out a Section 18 emergency exemption mechanism for states to request use of Furadan. Use restrictions were quite stringent and the Section 18 was initiated only when aphids exceeded an action level. Texas, Mississippi and Oklahoma chose to use Furadan under these restrictions and received the final okay from EPA in mid-July. In late July, the pathogenic fungus effectively reduced aphid populations. Later in the season, California applied for emergency use of Furadan and EPA readily approved its use on August 25 in the San Joaquin Valley to protect the crop from honeydew contamination. Monitoring reports document that our industry used the product in a safe manner. EPA and states are now working to make this product available under a Section 18 emergency in a timely manner for 1996. In fact, a meeting during this conference with EPA and state entomologists will continue this process.

Plant Bugs

Lygus populations were a huge problem in the Mid-South in 1994. As a result, more treatments were likely made this year during early squaring to eliminate the threat of plant bug damage. Insecticide resistance in Mid-South plant bugs continues to be a concern.

Insects in San Joaquin Valley of California

Insect and mite pests were again the major problem for San Joaquin Valley of California producers in 1995.

All reports pointed to 1995 as the worst *Lygus hesperus* year since 1978. Winter and spring rains produced high populations of Lygus in wild hosts and allowed a prolonged migration into nearby cotton fields. Silverleaf whitefly was lower in 1995 than 1994 levels. Actually, levels were similar to 1993. Because of weather and use of broad spectrum insecticides, some beet armyworm and cabbage looper outbreaks were experienced in the southern part of the valley.

Aphids were particularly troublesome in July and August and control of aphids was difficult because of resistance and reinvasion of fields within days. Late season aphid during boll opening was not a major factor, and thus quality was not affected in 1995.

In summary, the San Joaquin Valley crop suffered an 11.34% yield loss on its 1.26 million harvested acres, which translates to 283,712 bales. Control costs averaged $75.02 per acre.

Silverleaf Whitefly

The silverleaf whitefly continues to be a problem, especially in Arizona and in the Lower Rio Grande Valley of Texas. This year was much heavier than last year. In Arizona, scientists have documented that the silverleaf whitefly has now developed resistance to the most effective treatments, Danitol applied alone and the mixture, Danitol plus Orthene. Resistance occurred after only three years of use of Danitol. Arizona reported estimated insect control costs of $215 per acre. Whitefly required an average of 6.6 applications costing $22.00 each. Arizona entomologists and producer leadership met with EPA in December to discuss Emergency Exemptions for two insect growth regulators, Applaud from AgrEvo and Knack from Valent, for 1996 whitefly control on an emergency basis.

A Look to the Future of Cotton Insect Control

Over the last 40 years, we have proceeded through the three eras of chemical insecticides for cotton insect control. These are shown in Table 6. Following control failures and heavy damage resulting from worm pests across the cotton belt in 1997, Dr. Dan Clower of Louisiana State University, reported that "*... in Louisiana, resistance levels have become so high that none of the currently available insecticides can be depended upon to control serious outbreaks of tobacco budworm.*" It is curious that many entomologists have made similar observations over the course of this past season and that Graves's data on Alabama tobacco budworms, shown earlier, illustrates this. Clower also noted in the same 1977 report that "...eleven states were meeting with EPA to obtain Emergency Exemptions for three new synthetic pyrethroids and two new organophosphates." So, the 1977 "worm year" ushered in the third era of products which we are now using. It is coincidental that within the last month, eleven states have been in discussions with EPA to develop plans to secure emergency exemptions for three products, Pirate, Confirm and Furadan, for use in 1996. Actually, a second meeting is planned to be held during this conference. This may be the beginning of a new era using products shown here.

For tobacco budworms, we don't exactly know what this season will bring. However, we do know that genetically resistant individuals are now overwintering in the ground. We will see their offspring next year so we must be prepared. A good cold winter would help, Bt cotton will help, as well as having Pirate available. But realistically, we just do not have the insecticide chemistry to deal with moderate populations of tobacco budworm. In the short term, transgenic Bt cotton will be available in 1996 with enough seed to plant 2 to 3 million acres with a sufficient seed supply available in 1997.

Breakthrough chemical control products for tobacco budworm is focused on DowElanco's Spinosad products introduced last night as Tracer. These products will be available in an expanded Experimental Use Permit in 1996 and full registration in time for the 1997 season. Pirate is effective on resistant budworms, but its activity is outstanding for beet armyworm.

Actually, we are in better position to deal with beet armyworm. We have experience now and we know the role of biological controls. We also have a better understanding of how and when to use Dimilin, and we have the new products Pirate and Confirm; the biological, Spod-X; and new experimentals, Intrepid and Spinosad.

Tobacco budworm remains a real concern for the 1996 season. Many presentations this week will provide details on issues I only mentioned in passing, however, I hope this has given you at least an overview of the 1995 insect year.

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Table 1. Insect Losses: 89-94 Average vs. 1995

	89-94 Ave.	1995
Acres harvested	11.9 mil.	15.9 mil.
% yield loss	6.83%	11.08%
Bales lost	1,083,000	2,275,000
Cost per acre	$39.44	$57.93
Control costs	$468 mil.	$921 mil.
Lost yield	$389 mil.	$764 mil.
Total loss	$857 mil.	$1.685 bil.

Table 2. Acres Treated 89-94 vs. 1995 (in mil.)

	89-94	1995
Acres	11.9	15.9
Boll weevil	4.4	7.0
Bud/bollworm	6.5	9.3
Lygus	2.6	4.5
Aphids	3.5	5.2
Beet armyworm	0.7	2.6

Table 3. Bales Lost 89-94 vs. 1995 (in 000's)

	89-94	1995
Acres harvested	11,900	15,900
Boll weevil	223	451
Bud/bollworm	290	711
Lygus	126	209
Aphids	112	221
Beet armyworm	28	343
All insects	1,080	2,274

Table 4. Losses to Beet Armyworm, '93 vs '95

	1993	1995
Acres	12.9 mil.	15.9 mil.
Acres infested	3.4 mil.	6.8 mil.
Acres treated	1.7 mil	2.6 mil.
% yield loss	0.57%	1.68%
Bales lost	94,521	343,000

Table 5. Insecticide Resistance in Alabama Tobacco Budworms: Percent Kill (Graves, LSU 1995)

Insecticide (Class)	1994	1995	LSU Lab
Cypermethrin (Pyrethroids)	14	0	96
Methomyl (Carbamates)	60	12	86
Profenofos (O-phosphates)	48	4	87

Table 6. Cotton Insect Chemical Control Eras

57-67	67-78	78-present
DDT	DDT	Synthetic Pyrethroids
Endrin	Endrin	Bolstar
Toxaphene	Toxaphene	Curacron
Azodrin	Azodrin	Larvin
Sevin	parathions	Lannate
	Galecron/Fundal	Bt's
	Dimilin	

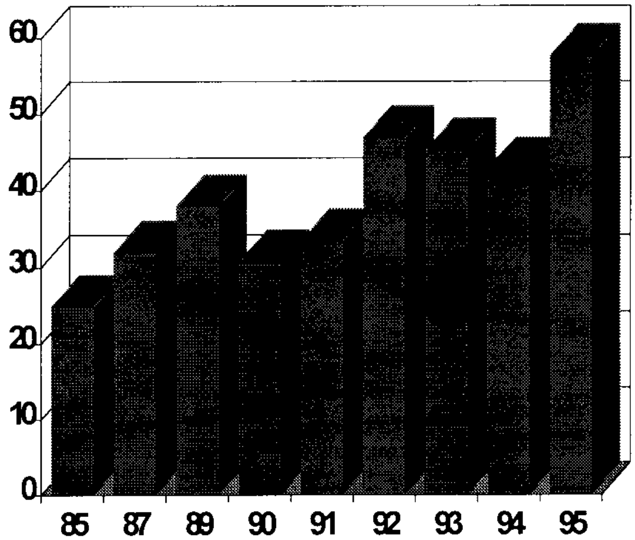

Figure 1. Beltwide costs of control shown in dollars per acre.

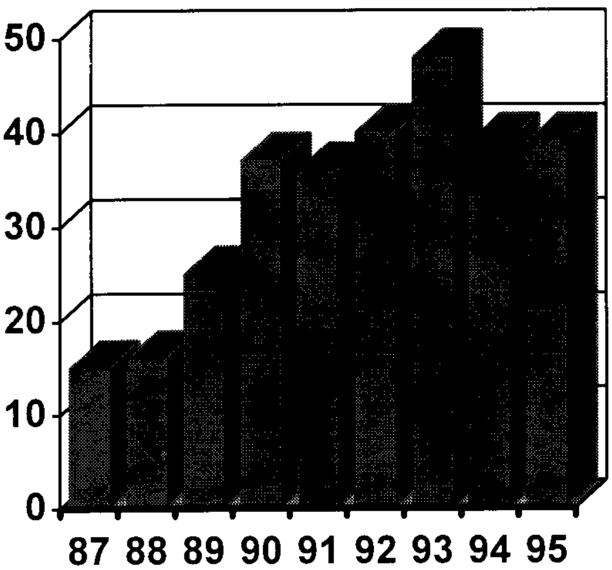

Figure 2. Pyrethroid resistance monitoring in tobacco budworms: Survival of adults to 10 micrograms of cypermethrin (Graves, LSU 1995)