PROGRESS OF BOLL WEEVIL ERADICATION IN THE U.S., 2005

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Abstract

The boll weevil eradication program in the United States began in 1983 to rid the Cotton Belt of the boll weevil, *Anthonomus grandis* Boheman. To date, the boll weevil has been eradicated from nearly 12.9 million acres of cotton in: Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Kansas, California, Arizona, and portions of Tennessee, Mississippi, Missouri, Arkansas, Louisiana, Oklahoma, Texas, and New Mexico; as well as from the neighboring regions of the Mexicali Valley, Sonoita, and Caborca in Mexico. The program is currently operating in the remaining 3.5 million acres of cotton in Tennessee, Mississippi, Missouri, Arkansas, Louisiana, Oklahoma, Texas, and New Mexico. As of this writing, 100 percent of the U.S. Cotton Belt is involved in boll weevil eradication, with over 80 percent having completed eradication and the remaining 20 percent nearing eradication. Nationwide eradication in the U.S. is expected by 2009. The remarkable environmental, biological, and economic benefits realized within the eradicated regions make boll weevil eradication one of the most important agricultural programs in U.S. history.

Introduction

The boll weevil, *Anthonomus grandis* Boheman, a native of Mexico and Central America, was first introduced into the United States near Brownsville, Texas, about 1892 (Hunter et al., 1905). By 1922, the pest had spread into cotton-growing areas of the U.S. from the eastern two-thirds of Texas and Oklahoma to the Atlantic Ocean. Northern and western portions of Texas were colonized by the boll weevil between 1953 and 1966 (Newsom and Brazzel, 1968).

In view of the economic and environmental problems posed by the boll weevil, and in recognition of the technical advances developed during more than 80 years of research, a cooperative boll weevil eradication experiment was initiated in 1971 in southern Mississippi and parts of Louisiana and Alabama (Parencia 1978; Perkins 1980). This experiment used an integrated control approach including chemical treatment, release of sterile male weevils, mass trapping, and cultural control. Based on this experiment, a special study committee of the National Cotton Council of America concluded that it was technically and operationally feasible to eliminate the boll weevil from the U.S.

Subsequent discussions among federal and state research agencies, extension, regulatory officials, and grower organizations led to a decision by USDA in 1977 to conduct two additional area-wide boll weevil eradication trials in Mississippi, and in northern North Carolina and southern Virginia. The success of these three-year boll weevil eradication trials, initiated in 1978 on 32,500 acres in North Carolina and Virginia, and on 32,000 acres in Mississippi, led to the cooperative boll weevil eradication program in the U.S. (USDA, 1991).

The cooperative boll weevil eradication program began in southern North Carolina (15,000 acres) and South Carolina (70,000 acres) in 1983, after the successful three-year boll weevil eradication trial in North Carolina and Virginia.

The program expanded into Georgia (287,500 acres) in 1987, Florida (107,000 acres) in 1987, southeastern Alabama (61,000 acres) in 1987, and Middle Tennessee (11,000 acres) in 1994 (James R. Brazzel, 1989; Sidney E. Cousins, 1991; Bill Grefenstette, 1996). Boll weevil eradication was completed in North Carolina, South Carolina, Georgia, Florida, and Alabama (excluding the northwestern portion) and Middle Tennessee in 1987, 1990, 1992, 1993, and 2000, respectively.

The program also began in the Imperial Valley of California (60,000 acres) in 1983, western Arizona in 1985 (70,000 acres), central Arizona in 1988 (420,000 acres), the Mexicali Valley of Mexico in 1988 (160,000 acres), and the Sonoita cotton region of Mexico in 1988 (5,000 acres). In 1991, boll weevil eradication was successfully completed in Southern California, Arizona, and northwest Mexico.

Environmental, biological, and economic benefits realized as a result of the success of the boll weevil eradication program in the southeast and the southwest (Carlson et al., 1989; USDA, 1991; Haney et al., 1996), led to program expansion into the rest of the U.S. Cotton Belt.

Tennessee ─ the program began in Region I (174,000 acres) of west Tennessee in 1998 (Jim Brumley, 1999), and expanded into Regions II and III (345,000 total acres) in 2000 (Figure 1).

Mississippi ─ after a brief pause, the program restarted in Region IV (70,000 acres) and began in Region III (400,000 acres) in 1997, then expanded into Region II (225,000 acres) in 1998 (Jim Brumley, 1999), and finally into Region I (600,000 acres) in 1999 (Figure 2).

Missouri ─ the program began in 2001 and included the entire cotton-growing area (405,000 acres) of the state (Figure 3).

Arkansas ─ the program started in the Southwest Zone (6,000 acres) in 1997 (Figure 4), in conjunction with the Louisiana Red River program, expanded into the Southeast Zone (300,000 acres) in 1999, the Central Zone (212,000 acres) in 2000, the Northeast Ridge Zone (135,000 acres) in 2001, and into Poinsett County (25,000 acres) in 2002 (Kiser et al., 2002). In 2003, the program expanded again into the Northeast Delta (300,000) (Danny Kiser and Michael Catanach, 2005).

Louisiana ─ the program started in the Red River Zone (66,000 acres) in 1997 (Figure 5), and expanded into the remainder of the state, referred to as the Northeast Zone (545,000) in 1999.

Oklahoma ─ the program began in 1998 and included the entire cotton-growing area (250,000 acres) of the state (Figure 6).

Texas ─ the program began in the Southern Rolling Plains (220,000 acres) in 1994 (Figure 7). The program was expanded in 1996 into the Rolling Plains Central (600,000 acres) and South Texas/Winter Garden (650,000) zones. In 1999, the program expanded again into the El Paso/Trans Pecos (50,000 acres), Western High Plains (800,000 acres), Permian Basin (700,000 acres), Northwest Plains (550,000 acres), and Northern Rolling Plains (350,000 acres) zones (El-Lissy et al., 1996 and 2000). In 2001, the program expanded into the Southern High Plains/Caprock (1,140,000 acres), Northern High Plains (550,000 acres), and Southern Blacklands (100,000 acres) zones (Smith et al., 2002). In 2002, the program expanded again into the Upper Coastal Bend Zone (188,000 acres) (Allen et al., 2003). In 2004, the program expanded into the St, Lawrence zone (150,000 acres) and the Panhandle zone (37,000 acres) (Allen et al., 2005). In 2005, the program started in the Northern Blacklands (100,000 acres) and the Lower Rio Grande Valley (250,000 acres) zones, which are the final two cotton-growing areas in the U.S. to join the eradication effort.

New Mexico ─ the program started in the South Central New Mexico and Luna County (32,000 acres) zones in 1998 (Figure 8), and expanded into the Pecos Valley Zone (15,000 acres) in 2000. The Lea County (17,000 acres) program began in 1999 as part of the Western High Plains of Texas, and the Roosevelt/Curry program began with the diapause phase in 2001 in conjunction with the Northwest Plains Zone of Texas.

This report provides a summary of boll weevil eradication in 2005, as well as an expected timeframe for nationwide eradication in the United States.

Materials and Methods

The operational success of the boll weevil eradication program hinges on three separate, yet interdependent components including: mapping, detection, and control.

Mapping

Mapping is one of the first phases of operation in any eradication zone. Mapping identifies the exact location of each cotton field and defines the surrounding environment. The methodology of mapping used in boll weevil eradication progressed from hand-drawn cotton fields on topographic county maps in the mid 1980's, to aerial photos in the late 1980's, to the Global Positioning System (GPS) in the early to mid-1990's. Currently, all active eradication zones are using differentially corrected GPS in the same or similar manner as described previously (Osama El-Lissy and John Moschos, 1999). Additionally, each field is identified with a unique number to provide for accurate data management (El-Lissy et al., 1996).

Detection

All eradication zones use the boll weevil pheromone trap as the primary tool of detection. Unique regional, ecological and environmental differences across the U.S. Cotton Belt have resulted in slight variations in trapping density and placement.

Post-eradication Zones:

Post-eradication zones include the cotton-producing areas that have already completed boll weevil eradication. Trapping in post-eradication zones is designed to provide early warning of any reintroduction of boll weevils ─ through natural migration or artificial movement. Early detection allows an immediate response in containing and eradicating the reintroduced population before it becomes established. The plan is to continue post-eradication trapping until nationwide eradication is complete, at which time a reduced but still effective trapping density will be employed for long-term protection.

Southeast ─ in Virginia, North Carolina, South Carolina, Georgia, Florida, and most of Alabama, traps were placed at approximately one trap per twenty acres in mid-June (pre-bloom growth stage) and inspected biweekly through November

(defoliation and harvesting). In Mississippi, Tennessee, Louisiana, and Arkansas, traps were placed at one trap per 10-20 acres, and inspected weekly and season-long (planting though harvesting).

Southwest ─ in Southern California (Imperial Valley), traps were strategically placed near the border and along major highways and interstates (All American Canal, I-8, and Hwy 98) at a trap every five miles and inspected monthly. In addition, traps are placed around Imperial County cotton fields at a density of one trap per 100 acres and inspected during the growing season. In Arizona, boll weevil traps were placed around all cotton fields in southern Arizona (within 50 miles of Mexico) and the southeastern counties at one trap per forty acres. In central and western Arizona, traps were placed at a density of one trap per 160 acres. All traps in Arizona were deployed at planting and inspected biweekly until defoliation.

Kansas ─ boll weevil traps were placed at a rate of one trap per 40 acres shortly after planting and inspected bi-weekly until harvest or a killing freeze.

Texas, Oklahoma, and New Mexico ─ traps were placed at approximately one trap per twenty acres and inspected weekly thought the growing season.

Active Eradication Zones:

Tennessee ─ traps were placed around the perimeter of all cotton fields, approximately 200 feet apart (averaging one trap per 1-2 acres), at or shortly after planting and inspected weekly through harvest or a killing freeze.

Mississippi ─ traps were placed at planting, approximately 350 feet apart, around the perimeter of each field (averaging one trap per 2-5 acres) in all regions, baited and inspected weekly through harvest or a killing freeze.

Missouri ─ traps were placed around the perimeter of all cotton fields, approximately 350 feet apart (averaging one trap per 4 acres), at or shortly after planting (2nd week of April) and inspected weekly (beginning May 6) through harvest or a killing freeze.

Arkansas ─ traps were placed around the perimeter of all cotton fields shortly after planting at approximately 300 feet apart (averaging one trap per 3 acres) and inspected weekly through harvest or a killing freeze.

Louisiana ─ traps were placed at planting, approximately 150 feet apart, around the perimeter of each field (averaging one trap per 2 acres) and inspected weekly through harvest or a killing freeze.

Oklahoma ─ traps were placed at one trap per 5 acres at planting and inspected weekly through harvest or a killing freeze.

Texas ─ traps were placed approximately 500 feet apart around the perimeter of each field (averaging one trap per 5-7 acres) in all eradication zones and inspected weekly until harvest or a killing freeze.

New Mexico ─ traps were placed at a rate of one trap per 5 acres and inspected season-long.

Control

The control part of the eradication program consists of *cultural, mechanical*, and *chemical* control.

1. Cultural Control:

Time-frames for uniform cotton planting and harvesting, as organized by growers, local agricultural extension service, and in some cases state regulatory agencies, are key components of cultural control in providing the necessary host-free period. In some states such as Arkansas and Texas, growers were offered a rebate to destroy crop residues as soon as possible after harvest in an effort to reduce overwintering populations and insecticide treatments.

2. Mechanical Control:

Although the primary function of the trap is detection, an indirect benefit of trapping, especially in low weevil populations, is that it removes a percentage of the population (Lloyd et al., 1972.)

3. Chemical Control:

a. Season-long phase – a single application of malathion (ultra-low-volume) was made, beginning at the pinhead-square growth stage, to fields that had reached the treatment criteria (action threshold). The 2005 season-long action threshold was a trap catch of 1-2 adult boll weevils per field (40 acres or less) in all active zones.

b. Diapause phase (2005) – in the Rio Grande Valley and the Northern Blacklands of Texas, weekly aerial applications with malathion ULV began on June 15 and July 15, respectively and continued until cotton fields were defoliated and harvested.

In 2005, malathion (Fyfanon® ULV) was used at a rate of 10 fl. oz./acre in Mississippi, Tennessee, Missouri and Arkansas, 12 fl. oz./acre in Oklahoma, Texas, and New Mexico, and at 16 fl. oz./acre in Louisiana.

All aircraft were equipped with differentially corrected GPS for documentation and quality control purposes in the same manner as described previously (El-Lissy et al., 1999).

Fields located within close proximity of sites designated as environmentally sensitive, or near permanent obstacles, were treated with high-clearance ground equipment. Mist-blowers mounted on pickup trucks were also used to provide accurate placement of insecticide on corners and edges of fields, and under power lines or other obstacles, where airplanes had less accessibility.

Results and Discussion

To date, the boll weevil has been eradicated from nearly 12.9 million acres of cotton in: Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Kansas, California, Arizona, and portions of Tennessee, Mississippi, Missouri, Arkansas, Louisiana, Oklahoma, Texas, and New Mexico; as well as from the neighboring regions of the Mexicali Valley, Sonoita, and Caborca in Mexico (Figure 9).

Post-eradication Zones:

Southeast – all post-eradication program activities in South Carolina, Florida, and Alabama are carried out by the Southeastern Boll Weevil Eradication Foundation (SEBWEF), headquartered in Montgomery, Alabama. In Georgia, post-eradication activities are performed by the Georgia BWEF. In Virginia and North Carolina, the state agriculture departments carry out the post-eradication activities with support from SEBWEF. In 2005, there were no weevils detected or acres treated by the program or producers in the entire states of Virginia (110,000 acres), South Carolina (330,000 acres), Georgia (1,500,000 acres), Florida (130,000 acres), and Alabama (610,000 acres). A single weevil was detected in North Carolina (970,000 acres) near Williamston. Further, there were no weevils captured in zones that have not yet been declared eradicated, including eradication zones in Tennessee (403,000 acres), Mississippi (1,500,000 acres), Missouri (101,000 acres), Arkansas (486,000 acres), and Louisiana (522,000 acres).

Southwest – post-eradication program activities in Southern California are carried out by the Imperial County Commissioner of Agriculture in El Centro; in Arizona by the Arizona Cotton Research and Protection Council in Phoenix, Arizona; and, in Mexico by Sanidad Vegetal in cooperation with USDA-APHIS**.** In 2005, there were no weevils detected or acres treated by the program or producers in the entire states of California (920,000 acres), Arizona (303,000 acres), or in northwest Mexico (60,000 acres).

Kansas – with the support of cotton producers in Kansas, program activities are cooperatively carried out by the Kansas Department of Agriculture and USDA-APHIS. There were no weevils captured or acres treated in the entire state (90,000 acres) in 2005.

Texas, Oklahoma, and New Mexico – post-eradication program activities in Texas and eastern New Mexico are carried out by the Texas Boll Weevil Eradication Foundation headquartered in Abilene, Texas. In Oklahoma, the program is implemented by the Oklahoma Boll Weevil Eradication Organization, headquartered in Hobart, Oklahoma. In south-central New Mexico, the program is implemented by the New Mexico Boll Weevil Eradication Control Committee headquartered in Las Cruces, New Mexico. In 2005, there were no weevils captured or acres treated by the program or producers in the cotton-growing acreages of eradicated zones in Oklahoma (252,000 acres), New Mexico (87,000 acres), or in Texas (4,555,000 acres). A seasonal total of 1,900 weevils were captured in the Southern Rolling Plains of Texas; presumably from migration and artificial movement from neighboring zones that had just started eradication in 2004.

Active Eradication Zones:

In 2005, the program was implemented on approximately 3.5 million acres of cotton in Tennessee, Mississippi, Missouri, Arkansas, Louisiana, Oklahoma, Texas, and New Mexico. Nationwide, the overall boll weevil populations in all active zones remained significantly lower than in the years when the program began in each zone.

Tennessee – the 2005 season-long mean number of weevils captured per trap per week in all active zones (217,000 acres) was significantly less than in the years when the program started in each zone. The 2005 season-long mean in Region I was reduced by 94.86 percent as compared to 2000; in Region II, it was reduced by 99.19 percent as compared to 2001; and in Region III, it was reduced by 97.84 percent as compared to 2001 (Ron Seward, personal communication)(Table 1).

Mississippi – the 2005 season-long mean number of weevils captured per trap per week in all active zones (120,000 acres) was significantly less than in the years when the program started in each zone. The 2005 season-long mean in Region I was

reduced by 99.96 percent compared to 2000; in Region II, it was reduced by 99.99 percent compared to 1999; and in Region III, it was reduced by 99.96 percent as compared to 1998 (Farrell Boyd, personal communication)(Table 1).

Missouri ─ the 2005 season-long mean number of weevils captured per trap per week in all active zones (304,000 acres) was significantly less than the first year of the program. The 2005 season-long mean in Region I was reduced by 82.41 percent compared to 2000; and in Region II, it was reduced by 79.37 percent compared to 2000 (Charles Rogillio, personal communication)(Table 1).

Arkansas ─ the 2005 season-long mean number of weevils captured per trap per week in all active zones (594,000 acres) was significantly less than in the years when the program started in each zone. The 2005 season-long mean in the Southeast Zone was reduced by 99.99 percent compared to 2000; in the Central Zone, it was reduced by 99.81 percent as compared to 2000; in the Northeast Ridge Zone, it was reduced by 99.10 percent as compared to 2001; and in the North Delta Zone, it was reduced by 97.27 percent as compared to 2003 (Danny Kiser, personal communication) (Table 1).

Louisiana ─ the 2005 season-long mean number of weevils captured per acre per month in the Red River Zone was reduced by 99.92 percent as compared to 2000. In the Northeast Zone, the mean was reduced by 99.99 percent as compared to 2000 (Table 1). The combined active acreage in these two zones was 348,000 acres.

Oklahoma ─ the 2005 season-long mean number of weevils captured per trap per week in the state-wide active zone (28,000 acres) was significantly less than in the first year of the program. The 2005 season-long mean was reduced by 98.65 percent compared to 2000 (Bill Massey, personal communication) (Table 1).

Texas ─ the 2005 season-long mean number of weevils captured per trap per week in all active zones (1,511,000 acres) was significantly less than in the years when the program started in each zone. The 2005 season-long mean in El Paso/Trans Pecos (EP/TP) was reduced by 99.86 percent as compared to the mean in 1999; in the Northern High Plains (NHP), it was reduced by 99.99 percent as compared to 2001; in the Northern Rolling Plains (NRP), it was reduced by 99.99 percent as compared to 1999; in the Permian Basin (PB), it was reduced by 99.82 percent as compared to 1999; in the Rolling Plains Central (RPC), it was reduced by 99.98 percent as compared to 1996; in the Southern Blacklands (SBL), it was reduced by 98.62 percent as compared to 2001; in the Southern High Plains/Caprock (SHPC), it was reduced by 99.98 percent compared to 2001; in the St Lawrence (STL), it was reduced by 89.86 percent compared to 2004; in the South Texas/Winter Garden (ST/WG), it was reduced by 98.36 percent compared to 1996; in the Upper Coastal Bend (UCB), it was reduced by 98.35 percent compared to 2002; and in the Western High Plains (WHP), it was reduced by 99.99 percent compared to 1999 (Charles Allen, Texas Boll Weevil Eradication Foundation, 2005) (Table 1).

New Mexico ─ the 2005 season-long mean number of adult weevils captured per trap per week in the Pecos Valley (3,500 acres) and Lea County (1,500 acres) was significantly less than previous years. The 2005 mean in the Pecos Valley was reduced by 99.99 percent as compared to 1999; and in Lea County, it was reduced by 99.99 percent as compared to 1999 (Table 1).

Program Expansion in 2005:

In 2005, cotton producers in the Upper Blacklands (100,000 acres) and Lower Rio Grande Valley (250,000 acres) zones in Texas approved referenda to join the eradication program. As a result, all cotton-growing regions of the U.S. are either involved in active eradication, or have already completed the program.

Acknowledgments

The nationwide boll weevil eradication program exemplifies an unsurpassed effort by federal, state, and industry cooperators in ridding the U.S. cotton industry of its most devastating pest. The operational success of the program is entirely due to the tireless efforts of grower organizations, including the Southeastern Boll Weevil Eradication Foundation, Georgia Boll Weevil Eradication Foundation, Mississippi Boll Weevil Management Corporation, Arkansas Boll Weevil Eradication Foundation, Louisiana Department of Agriculture and Forestry, Texas Boll Weevil Eradication Foundation, Oklahoma Boll Weevil Eradication Organization, South Central New Mexico Boll Weevil Control Committee, Pecos Valley Boll Weevil Control Committee, Arizona Cotton Research and Protection Council, Imperial County Commissioner of Agriculture, and Kansas Department of Agriculture. The leadership of the National Cotton Council and technical and operational support of the Extension Service, state agriculture departments and USDA continues to play an instrumental role in the success of boll weevil eradication in the U.S.

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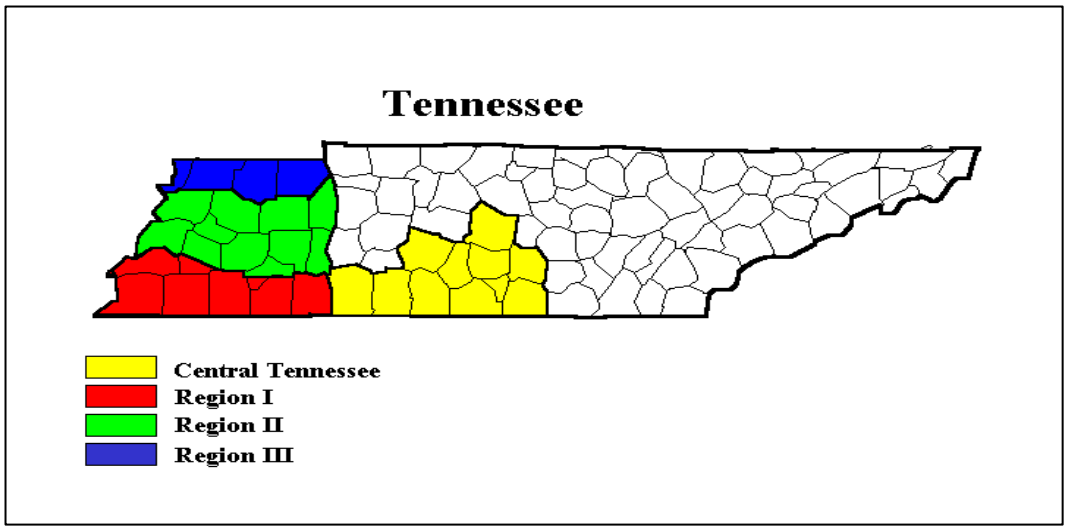

Figure 1. Tennessee Boll Weevil Eradication Zones

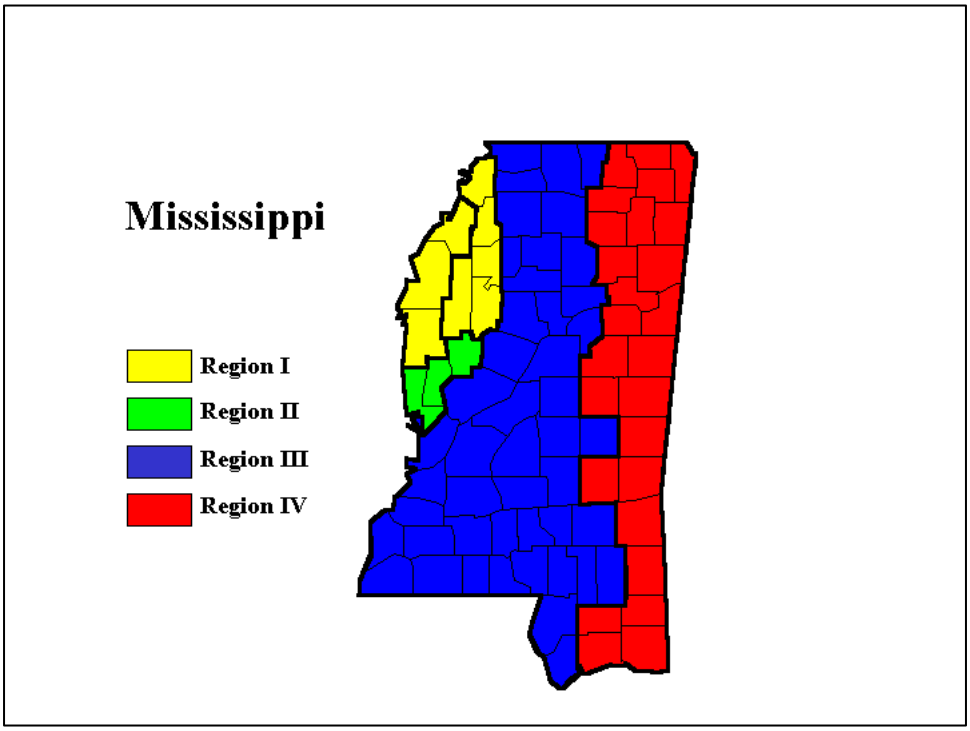

Figure 2. Mississippi Boll Weevil Eradication Zones

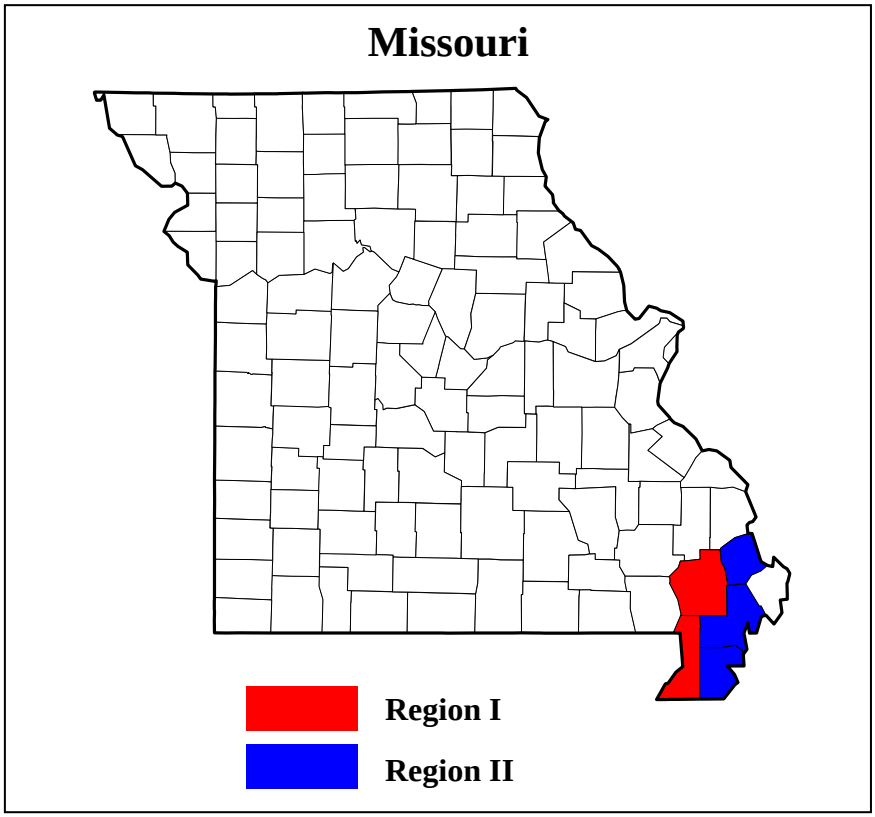

Figure 3. Missouri Boll Weevil Eradication Program

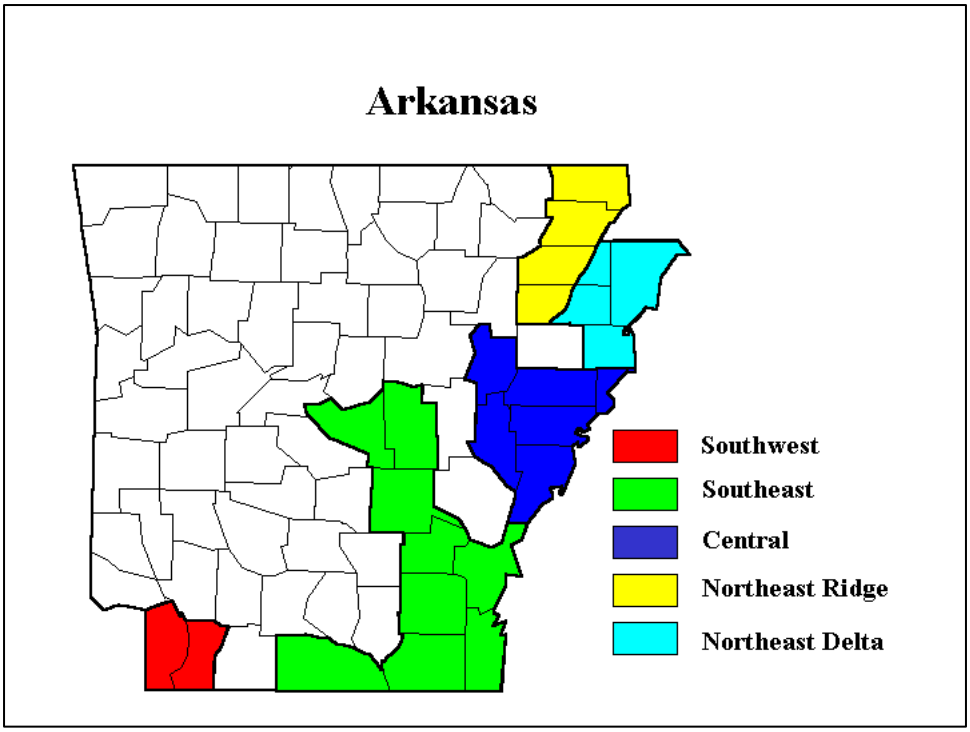

Figure 4. Arkansas Boll Weevil Eradication Zones

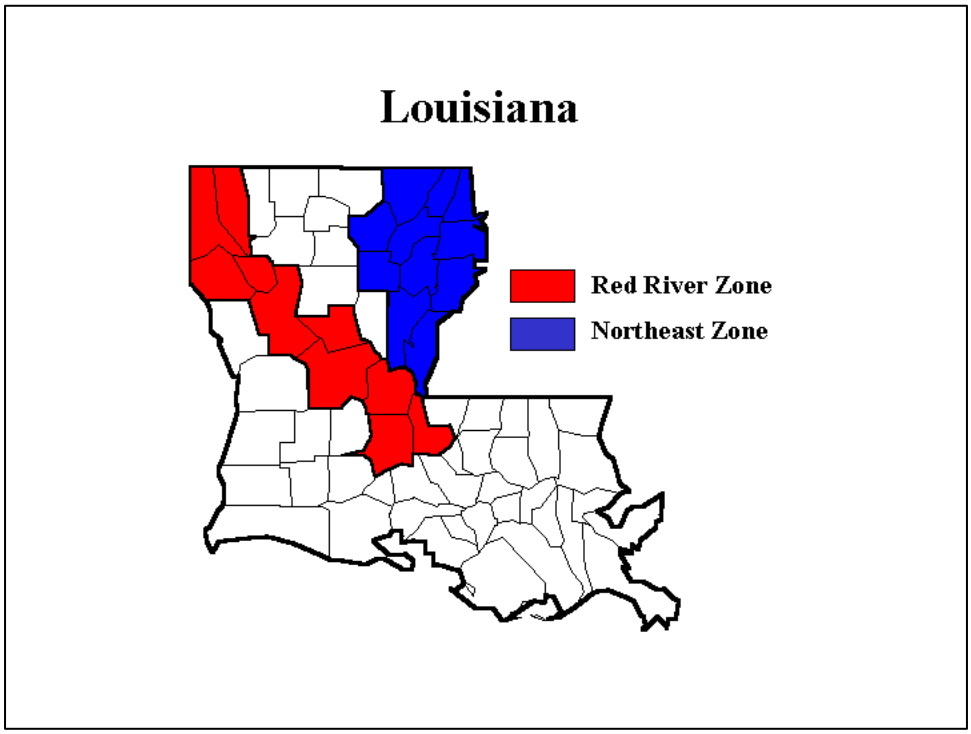

Figure 5. Louisiana Boll Weevil Eradication Zones

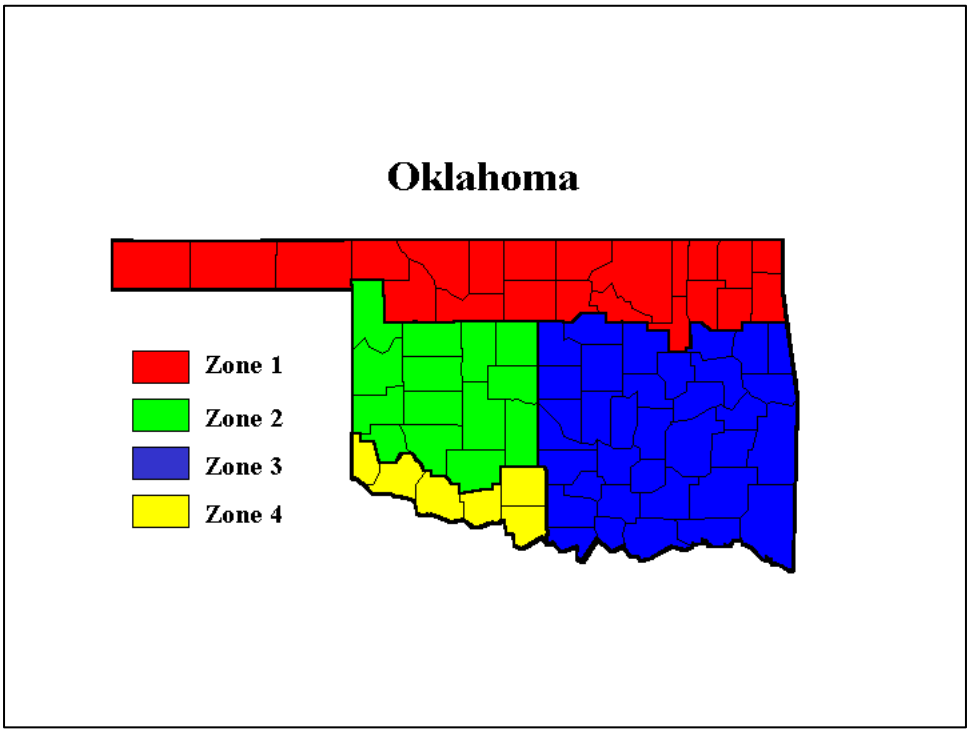

Figure 6. Oklahoma Boll Weevil Eradication Zones

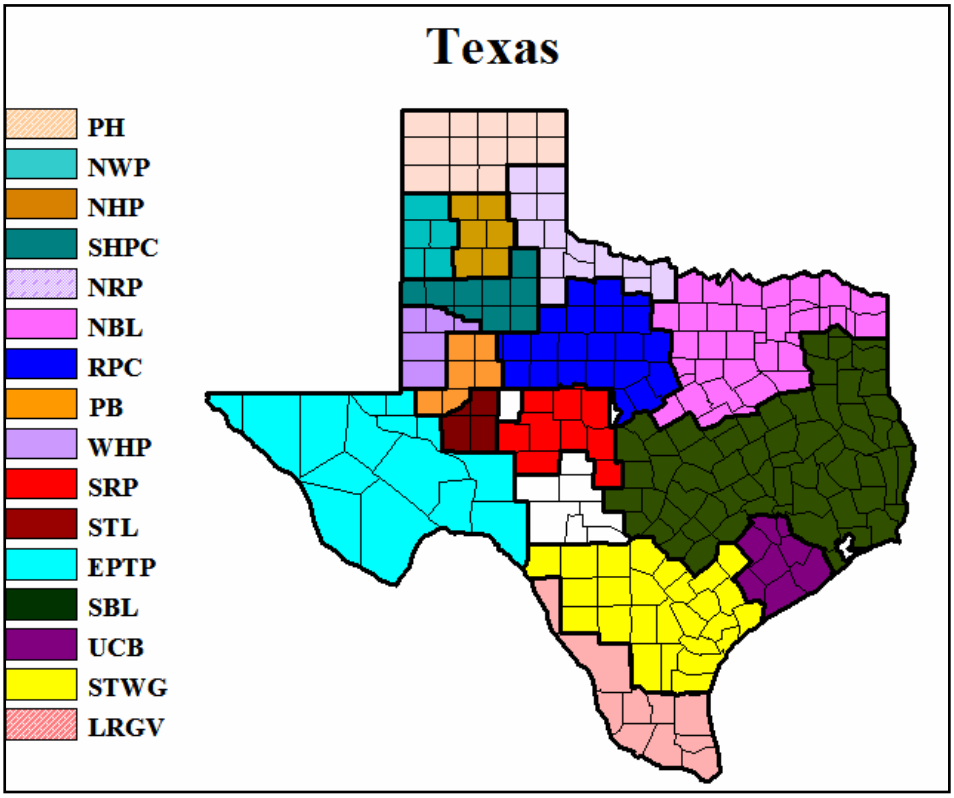

Figure 7. Texas Boll Weevil Eradication Zones

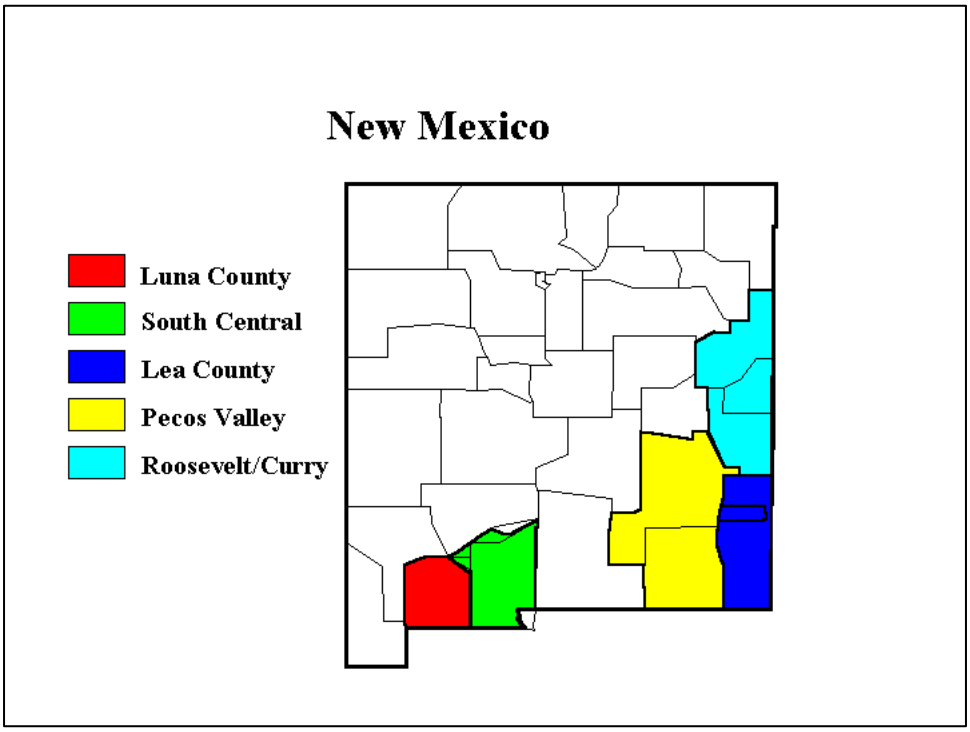

Figure 8. New Mexico Boll Weevil Eradication Zones

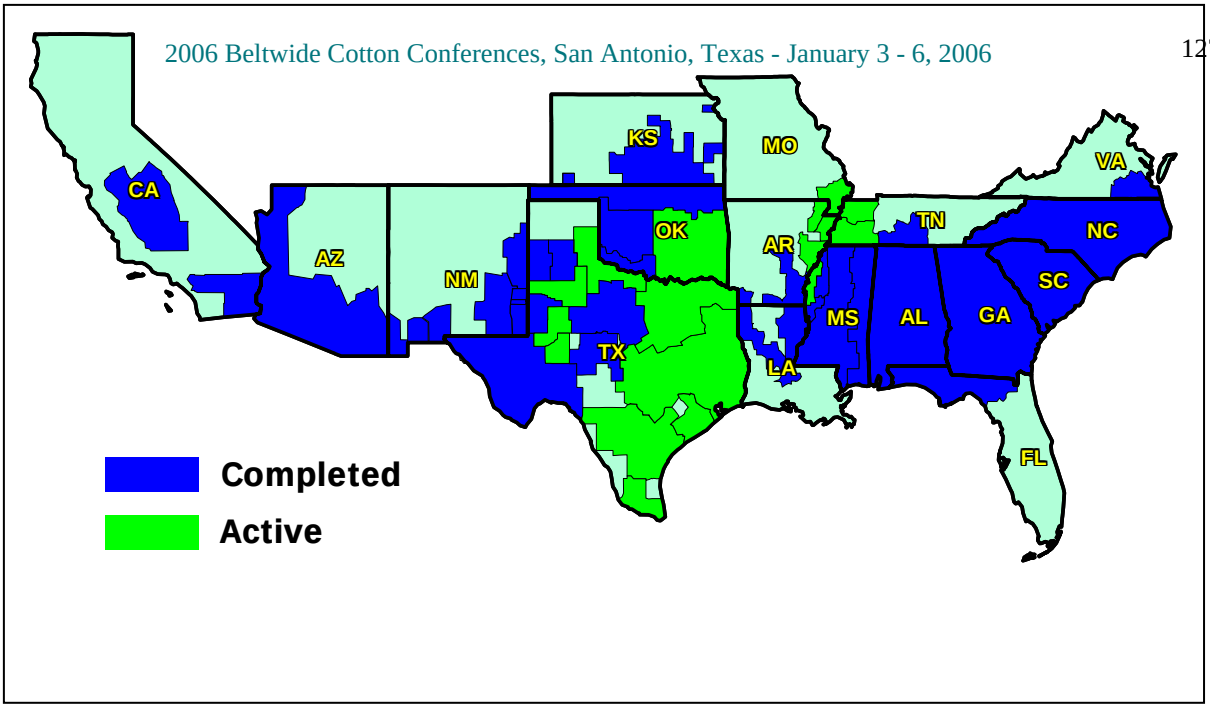

Figure 9. Boll Weevil Eradication Program in the U.S., 2005

Table 1. Percent reduction in the 2005 season-long mean number of weevils captured per trap as compared with the first year of the program in each active eradication zone, USA, 2005.

State	Eradication Zone	Year Program Started	First Year Mean	2005 Mean	Percent Reduction
Tennessee	Region I	2000	1.50	0.077	94.86
	Region II	2001	0.16	0.001	99.19
	Region III	2001	0.06	0.001	97.84
Mississippi	Region I	2000	2.50	0.001	99.96
	Region II	1999	2.00	0.000	99.99
	Region III	1998	13.80	0.005	99.96
Missouri	Region I	2000	19.50	3.430	82.41
	Region II	2000	6.30	1.300	79.37
Arkansas	Southeast Zone	2000	5.54	0.001	99.99
	Central Zone	2000	15.66	0.029	99.81
	Northeast Ridge Zone	2001	8.70	0.081	99.10
	North Delta Zone	2003	9.58	0..260	97.27
Louisiana	Red River Zone	2000	0.05	0.000	99.92
	Northeast Zone	2000	0.85	0.000	99.99
Oklahoma	State-Wide	2000	1.70	0.023	98.65
Texas	El Paso/Trans Pecos (EP/TP)	1999	0.21	0.000	99.86
	Northern High Plains (NHP)	2001	0.89	0.000	99.99
	Northern Rolling Plains (NRP)	1999	18.54	0.000	99.99
	Permian Basin (PB)	1999	9.99	0.018	99.82
	Rolling Plains Central (RPC)	1996	16.99	0.003	99.98
	Southern Blacklands (SBL)	2001	13.68	0.188	98.62
	Southern High Plains (SHP)	2001	1.16	0.000	99.98
	St Lawrence (STL)	2004	3.56	0.361	89.86
	South Texas/Winter Garden	1996	12.82	0.210	98.36
	Upper Coastal Bend (UCB)	2002	18.22	0.301	98.35
	Western High Plains (WHP)	1999	18.20	0.000	99.99
New Mexico					
	Pecos Valley	1999	10.0	0.000	99.99
	Lea County	1999	10.3	0.000	99.99