BOLL WEEVIL ERADICATION STATUS IN TEXAS

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Abstract

A large-scale boll weevil eradication program was initiated in Texas in an effort to rid the state of the cotton boll weevil, *Anthonomus grandis* Bohman. The cotton growing area in the state has been divided into nine zones, each encompassing between 150,000 and 3.9 million acres of cotton. The plan is to complete the eradication of the boll weevil within the next 10 years.

The program was first initiated in the Southern Rolling Plains (SRP) on 200,000 acres of cotton in September of 1994 with the diapause phase. All cotton fields in the SRP received a single application of malathion ULV during the week of September 26, and every week thereafter until all hostable plants and food supply were eliminated by harvesting and stalk destruction or a killing freeze. The total cumulative number of acres treated was 866,363, averaging 4.3 applications per acre. For evaluation purposes prior to the first application, boll weevil traps were placed at a density of one trap per five acres around the periphery of 22 randomly selected fields. Traps were inspected weekly.

The season-long phase of the program was initiated during the spring of 1995. Boll weevil traps were placed during planting around all cotton fields at a density of one trap per five acres and were inspected on a weekly basis. A single malathion ULV application was made to fields that had reached the treatment criteria (action threshold). The threshold was trap catch of two adult boll weevils per field at matchhead square. The action threshold was increased to eight adults per field beginning August 7 in an effort to reduce the use of insecticide during mid-season, and decreased to five adults per field beginning September 18 for the remainder of the season. The total cumulative number of acres treated season long was 1,862,522 acres, averaging 8.5 applications per acre. The overall mean number of boll weevils captured per trap during the fall of 1995 was significantly less than 1994. The 1995 mean was 2.7 and the 1994 mean was 50.6, a reduction rate of 94.7%.

In the spring of 1995, the program was initiated in the Lower Rio Grande Valley (LRGV) on 365,000 acres of cotton with the season-long phase. Cotton fields received two malathion ULV applications (at 7-9 day intervals) when the initial action threshold was reached. One additional application was made on each subsequent occasion that the threshold was exceeded. The action threshold was increased to five adults per field in mid-season (June 12), and to10 in the latter part of the growing season (July 3). The total cumulative number of acres treated season long was 1,928,164 acres, averaging 5.4 applications per acre. With 1995 being the first year of the program, there was no program trapping data collected from the previous year for comparison as was the case in the Southern Rolling Plains. Definite conclusions may not be made until comparative data is collected in 1996.

These results demonstrate that the area-wide eradication approach, utilizing pheromone traps with sound cultural, mechanical and chemical controls, represents an effective strategy in reducing the boll weevil populations as planned and subsequently eliminating the pest.

Introduction

The boll weevil, *Anthonomus grandis* Bohman, 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 United States 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 during a subsequent range expansion that occurred between 1953 and 1966 (Newsom and Brazzel, 1968). By 1981, the pest was well established in parts of California, Northwestern Mexico and Arizona. As early as 1895, recognition of the tremendous damage caused by this insect was noted. Recommendations were made to terminate cotton production in the infested region, and to establish and maintain a cotton-free zone along the Rio Grande River bordering Mexico. In 1903 the Texas Legislature offered a $50,000 cash reward for a practical way to control the boll weevil.

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In 1904, Sanderson tried to hand pick infested squares off cotton plants in an attempt to prevent weevil reproduction. In the same year, Hunter concluded that there was not even a remote possibility that the boll weevil would be eradicated. Since that time, numerous methods of control have been tested and reported.

From 1917 until the late 1940s, the most effective method of control was the use of short-season early maturing cotton varieties and dusting with calcium arsenate (Howard, 1918 and Isley, 1950). During World War II, DDT and other chlorinated hydrocarbons were developed and made available to control many insect pests including the boll weevil (Walker et al., 1949). In 1957, Roussel et al. reported that boll weevils were becoming resistant to the chlorinated hydrocarbons and within two years resistance was widespread throughout the cotton belt. In addition, concern was growing about the destruction of beneficial insect populations and the widespread occurrence of organochlorines in the environment. Thus, organochlorines were gradually abandoned in favor of organophosphate insecticides. Although the boll weevil has shown resistance to organophospates in Central America, it has not yet developed resistance in any portion of the United States.

In 1959, Brazzel et al. discovered that the boll weevil enters diapause during late summer and early fall in ground trash to overcome the absence of host plants and cold winters. In 1964, Earle et al. noted that temperature and photoperiod are key environmental factors that control the onset of adult diapause in the boll weevil. In 1973, Carter et al. documented that boll weevil diapause is related to changes in fruiting activity of the cotton plant. He reported further that diapause occurred in approximately 20 to 50 percent of adults when larval development coincided with decreasing fruiting levels, and 50 to 100 percent as true cut-out approached.

In 1959, Brazzel et al. employed insecticide applications late in the season "diapause" phase, as the cotton crop approached maturity to destroy diapausing weevils before they entered hibernation sites. Thus, the size of the spring emerging populations during the subsequent planting season was greatly reduced. This approach was further tested by Adkisson et al. (1965) and Lloyd et al. (1966).

In 1966, Cross and Mitchell showed conclusively that the male boll weevil produces a wind-borne sex attractant (pheromone) that is attractive to fe-males. In 1964, Keller et al. isolated the boll weevil sex attractant by drawing air from caged males through a column of activated charcoal to which female weevils quickly responded in a laboratory test. In 1968, Cross and Hardee demonstrated, and Bradley et al., supported that the pheromone of the male boll weevil is not only a sex pheromone for females, but also an aggregating pheromone for both sexes. In 1968, Tumlinson et al. reported on the first syn-thesis of one of the boll weevil pheromone compounds. In 1972, Gueldner et al. improved the synthesis and produced approximately 1 kg. for field stud-ies. Several improved synthesis routes have been developed since, and the boll weevil pheromone (grandlure) has been procured from manufacturers.

As the techniques for formulating grandlure improved, the designs of boll weevil traps did also (Hedin et al., 1976). A wing trap coated with Stikem® and a Plexiglass® oblique funnel trap was selected for general use (Cross et al., 1968). In 1971, Hardee et al. used plywood wing traps painted dark green and metal traps painted yellow in large tests in Texas. In the same year, Cross et al. found that weevils were most attracted to the daylight fluorescent yellow color traps. Later in the same year, Leggett et al. developed the Leggett trap as a competitive non-sticky trap that utilized the behavior patterns of the boll weevil for the most efficient capture.

Traps baited with grandlure were found to be eight times more effective than manual whole-plant examination in detecting very low density of boll weevil infestation (Hardee et al., 1975). Rummel et al. (1980), developed a trap index system for West Texas to predict the need to treat overwintered weevils based on catches in pheromone traps before the one-third grown square stage.

In the same year Parker et al. (1980) reported that the application of early-season insecticide treatment reduced the number of the overwintered boll weevils before they establish the nucleus of an F1 generation. Rummel et al. (1980), and Benedict et al. (1985) suggested that the grandlure baited trap can be used as an effective sampling tool for low population densities of overwintering boll weevils as they emerge in early spring and search for fruiting cotton. Rummel et al. (1980) suggested that 2 percent oviposition-damaged squares following the appearance of one-third grown squares as the level of damage that was predicted to occur between trap index 1.0 and 2.5 on untreated cotton.

Yield losses attributed to the boll weevil, the cost of insecticide control, environmental considerations, infestation of secondary insect pest problems and insect resistance have all resulted in an aggressive effort to develop a beltwide strategy for controlling the boll weevil in the United States.

Although most growers judiciously apply control measures to boll weevil infested acreage, in almost all such areas, 5 to 20 percent of the infested acreage may receive inadequate or no control treatments (Knipling, 1979). This uncontrolled acreage harbors populations capable of reinfesting neighboring areas. Models developed by Knipling (1979) demonstrate that if only 10 percent of a population remains untreated, that portion of the population can develop normally and redistribute throughout the entire area after only four generations or in less than one growing season. Also, judicious application of control measures cannot protect against reinfestation from neighboring areas the following season. Thus, growers who treat their acreage are faced with a continuing need to reapply insecticide to control reinfestations.

Approximately $70 million is spent annually for boll weevil control, and the pest still causes an estimated $200 million in crop losses each year (Knipling, 1964). In recent years, these figures may have increased by 50% (Hedin et al. 1976). It is generally agreed that cotton cannot be profitably grown in areas where the insect cannot be controlled and other control strategies are imperative.

In view of the economic and environmental problems posed by the boll weevil and in recognition of the technical advances developed over almost 100 years by hard working and talented scientists, a cooperative boll weevil eradication experiment was initiated in 1971 in southern Mississippi and parts of Louisiana and Alabama. This experiment used an integrated control approach including chemical treatment, releases of sterile males, 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. The success of the 3-year boll weevil eradication trial, initiated in 1978 on 32,500 acres in North Carolina and Virginia, led to the Southwestern and Southeastern boll weevil eradication programs (USDA, 1991).

The Southwest Boll Weevil Eradication Program was implemented in 1985 to eradicate the boll weevil in approximately 233,000 acres in western Arizona, southern California and northwest Mexico. In 1988, the program was expanded to include an additional 320,000 acres of cotton in central Arizona. The eradication in southern California and western Arizona was completed in 1987 and in 1991 in central Arizona.

The Southeast Boll Weevil Eradication Program was implemented in 1983 to eradicate the boll weevil from approximately 130,000 acres of cotton in the remaining area of North Carolina and in northern South Carolina. This was followed in 1987 with a program in the remainder of South Carolina and in Florida, Georgia and southern Alabama (21 counties) to eradicate the boll weevil from an additional 400,000 acres. The program also maintained previously eradicated areas in Virginia and the Carolinas as a part of the post eradication plan (USDA, 1991). A buffer zone on the western edge of the eradication area was maintained to prevent boll weevil populations from moving back into the eradication zone. The Southeast Program has since expanded to eastern Mississippi, middle Tennessee and the remainder of Alabama. More than 3.2 million acres in six states are now producing cotton without the boll weevil in the Southeastern United States.

In 1993, the Texas Boll Weevil Eradication Foundation was established by the Texas Legislature to govern and oversee the implementation of the boll weevil eradication program in Texas. The Foundation has divided the cotton growing area in the state into nine eradication zones each encompassing between approximately 150,000 and 3.9 million acres. The Southern Rolling Plains (SRP) zone was the first to start the program in the fall of 1994 on 220,000 acres. In the spring of 1995, the program was initiated in the Lower Rio Grande Valley (LRGV) zone on approximately 360,000 acres. In 1996, the program is scheduled to begin in the South Texas/Winter Garden zone which includes approximately 660,000 acres, and in the Central Rolling Plains zone, which includes approximately 700,000 acres. Both zones will begin the program with the diapause phase of the eradication process.

Materials and Methods

The cotton growing area in Texas which encompasses approximately 7 million acres, has been divided into nine eradication zones as follows:

1. Southern Rolling Plains (SRP), (220,000 acres).
2. Lower Rio Grande Valley (LRGV), (360,000 acres).
3. South Texas/Winter Garden (STWG), (660,000 acres).
4. Central Rolling Plains (CRP), (700,000 acres).
5. St. Lawrence (St.L), (150,000 acres).
6. Northern Rolling Plains (NRP), (797,000 acres).
7. Blacklands, (225,000 acres).
8. High Plains (HP), (3.9 million acres).
9. El Paso/Trans Pecos (EPTP), (60,000 acres). (Figure 1)

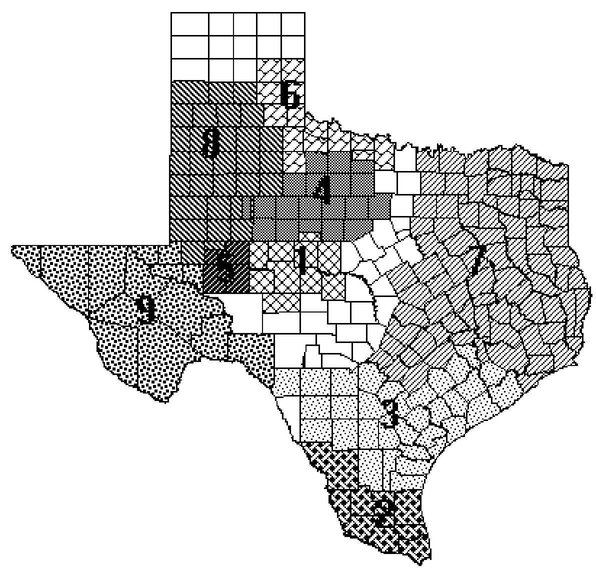

Figure 1: Boll weevil eradication zones in Texas.

Mapping

Mapping is one of the first phases of operations in any eradication zone. The purpose of mapping is to identify the exact location of each cotton field as well as the surrounding environment. Each cotton field in the state is identified with a unique number as indicated in the following description: Each zone is divided into "work units" of about 15,000-18,000 acres of cotton. Each work unit has a unique three digit number. The first of the three numbers refers to the zone number, while the second two refer to each work unit (within the zone), using an arbitrary series of numbers beginning with one. A work unit has several townships (6x6 miles) numbered arbitrarily within each work unit. Each of the 36 square miles within a township is called a "section," which measures 1 mile x 1 mile. The sections are numbered in a zigzag manner, beginning east to west. The first section (1), occurs in the northeast corner of the township and the last section, (36), lies in the southeast corner of the township. All fields within each section are identified and assigned a unique four-digit number. The first two digits refer to the section number and the second two digits refer to a series of numbers within each section beginning with one. Applying this numbering system results in a unique number for each cotton field throughout the state.

In the SRP, all cotton fields were mapped using the differentially corrected Global Positioning System (GPS) before malathion applications commenced in 1994. The GPS is based on a system of satellites developed by the U. S. Department of Defense. Now fully operational, the system has 24 satellites orbiting the Earth at an altitude of 11,000 miles. Program personnel used hand held receivers (Scout Master, Trimble Navigation) capable of receiving satellite signals and calculating the precise reference points to triangulate a location (latitude/longitude). By measuring the travel time of signals transmitted from each satellite, the receiver computes its distance from that satellite. With distance measurements from at least three satellites, the hand held units can calculate the latitude / longitude within 100 meters (error range) from the exact location. This error was intentionally designed and transmitted by the U. S. Department of Defense for national security purposes. The program used a real time FM hand held differential correction receiver (DCI 3000) that was connected to each of the GPS units to calculate and correct the difference (100 meters) to a sub-meter error. The GPS works anywhere on Earth, 24 hours a day and in any weather. Using the GPS hand held units, latitude and longitude readings were taken at every corner (point) around each field. Points were stored in the GPS hand held units, taken to the office, and downloaded into MapInfo version 3.0 (mapping software) via a specially written computer routine (written in-house) that was designed to sort and connect the points. MapInfo is then capable of taking the readings, drawing the exact shape and location, and then superimposes each field onto layers of maps. Each layer provides a detailed map of counties, streets, rivers and other major or permanent fixtures producing comprehensive maps. These maps indicate the exact location of each field with an error range of less than one meter, as well as the exact number of acres within each field. Field maps are stored in the computer and used for trapping, and insecticide applications, as well as other program activities. Due to the delayed start in the LRGV, the GPS was not utilized for mapping before the start up of the program in 1995. Instead, a copy of the aerial photo produced by the USDA, Consolidated Farm Services Agency (CFSA) was utilized.

<u>Trapping</u>

Boll weevil traps (Foundation traps) were baited with one-inch square laminated polyvinyl chloride dispensers impregnated with 10 mg. of a mixture of boll weevil aggregation and sex pheromone (grandlure). Traps were placed along the edges of all cotton fields on a four-foot long wooden stake driven into the ground. Each trap was set on a nail (driven halfway in) on top of the stake to hold it upright in the event of high wind or any other disturbance. Traps were placed as near to the cotton field as possible (and practical), yet in a position which avoided the regular path of field equipment or other traffic to minimize trap mortality and maintain a high level of trap effectiveness. Traps were placed at a density of one trap per five acres of cotton, and doubled to one trap per 2.5 acres alongside boll weevil hibernation sites. Approximately 39,400 traps were deployed in the SRP and 69,000 in the LRGV during the 1995 cotton season. Each trap was identified with a unique number to precisely pinpoint the location of each trap capture. Traps were inspected once a week, except during adverse weather conditions, replacing pheromone dispensers every two weeks. One insecticide dispenser (1 x ½ inch laminated polyvinyl chloride impregnated with 0.6 gm. of dichlorvos) was placed in the trap with the lure to kill weevils entering the trap. The insecticide strips were replaced once a month. Crop phenology adjacent to each trap was recorded based on a designated code system. The Crop Phenology Code System utilized was: (0) seedlings or Cotyledan, (10) 1 or two leaves, (20) three or four leaves, (30) five or six leaves, (31) five or six leaves and first sign of pinsquare, (41) seven or eight leaves and first sign of pinsquare, (42) seven or eight leaves and 1/3 grown square, (51) nine or 10 leaves and first sign of pinsquare, (52) nine or 10 leaves and 1/3 grown square, (60) bloom, (70) open bolls, (80) defoliated, (90) picked or stripped, (91) shredded, (92) plowed.

Quality Control: The purpose of quality control was to ensure that program guidelines for boll weevil trapping were being properly implemented. Quality control was conducted throughout the season by randomly selecting a minimum of 15 percent of all fields in each work unit on a weekly basis. Quality control includes: (1.) Visual Inspection - Trapping density, trap position, trap condition, lure and insecticide strip replacement, and crop phenology were evaluated. (2.) Planting weevils (Spiking) - The quality control supervisor planted a known number of weevils and/or tokens in a percentage of traps around the fields selected for quality control that week. Information gathered by the quality control supervisor was compared with the daily trapping report submitted by the trapper. This comparison was made to verify accurate trapping information.

Control

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

(1.) Cultural Control: The uniform planting of cotton and harvesting windows organized by growers in each zone is a key component of the cultural control in providing the necessary host-free period. In the SRP, planting began on May 15, and on February 15 in the LRGV. In zones with mandatory stalk destruction rules and regulations, where temperate climates may induce regrowth during the winter months (off-season), program personnel assisted the Texas Department of Agriculture (TDA) in maintaining a host-free period during the off-season months. Program personnel provided TDA with infor-mation to identify fields that were out of compliance with the plow-up regula-tions before the stalk destruction date (September 1 in the Lower Rio Grande Valley). This information included field maps, crop stage and grower names. Following the plow-up date, program personnel continued to monitor weevil population and fields on biweekly basis. Information on fields that had regrowth and/or volunteer cotton was provided to TDA for reinforcement.

(2.) Mechanical control: While the primary function of the trap was to measure the adult boll weevil population densities and identify their locations, another key benefit was removing segments of these populations in the process. In the SRP traps removed a total of 3,144,161 adult boll weevils during the 1995 season, and in the a LRGV a total of 10,855,292.

(3.) Chemical Control: In the SRP zone, malathion ULV (Fyfanon) at 16.0 oz/ac applications were made weekly on all cotton fields starting September 26, 1994 (diapause phase) until there were no longer any hostable plants in which weevils could reproduce or serve as a food supply. The total number of acres that received applications were 181432, 170486, 154567, 132485, 22773, 93352, 58852, 12703, 33967 and 5746 during the weeks ending October 2, 9, 16, 23, 30, November 6, 13, 20, 27, 4, respectively. Totaling 866,363 cumulative acres treated, and averaging 4.33 applications per acre. In the spring of 1995, a single malathion ULV application was made when the trap capture reached two adult weevils per field and crop phenology was matchhead size square or older. The first application was made on June 21, 1995. The application threshold was increased to eight adult weevils per field beginning August 7, and decreased to five effective September 18, and continued to be five for the remainder of the season. Based on the above criteria, the program treated 905, 5126, 18624, 67241, 133619, 64323, 0 (rain), 36289, 22418, 68046, 105014, 98835, 85029, 99890, 182652, 179975, 149407, 156288, 125354, 69285, 43665, 64561, 26846, 56332, 1280, and 461 acres during the weeks ending June 25, July 2, 9, 16, 23, 30, August 6, 13, 20, 27, September 3, 10, 17, 24, October 1, 8, 15, 22, 29, November 5, 12, 19, 26, December 3, 10, 17 respectively. Totaling 1861465 cumulative acres treated, and averaging 8.36 applications per acre. The aerial application rate of malathion ULV was reduced to 12 oz/ac effective July 15, 1995 (Jones et al., 1995). Approximately 99% of all applications were made by air, requiring a total of 20 contracted airplanes, and 1% were made by ground, which required one high clearance ground sprayer. Nine mist blowers mounted on pickup trucks were required to spray edges of fields along side power lines and other obstacles that were less accessible by air.

In the LRGV, two malathion applications were made when trap catch reached two adult weevils per field and crop phenology was at matchhead size square or older. The threshold was increased to five beginning June 12, and again to 10 beginning July 3 to trigger one application. Based on this criteria the number of acres that received applications were 369, 3080, 22537, 83443, 101453, 155954, 108912, 78166, 45064, 99384, 183322, 177680, 173582, 133927, 148156,103494, 93467, 45862, 16162, 11891, 11303, 4631, 5407, during the weeks ending April 4, 16, 23, 30, May 7, 14, 21, 28, June 4, 11, 18, 25, July 2, 9, 16, 23, 30, August 6, 13, 20, 27, September 3 and 10, respectively. Totaling 1,928,164 cumulative acres treated and averaging 5.4 applications per acre. The aerial application rate of malathion was reduced from 16 to 12 oz/ac effective July 15. Approximately 96% of total treated acres were sprayed aerially requiring 30 contracted airplanes, and 4% by ground requiring five high clearance ground sprayers and 14 mist blowers.

Aerial applications were made by airplanes equipped with a spray system designed and calibrated to deliver ultra low volume. Stainless steel tip (8002) nozzles were evenly installed on spray booms, mounted near the trailing edge of each wing. A centrifugal or electric pump was used to generate a pressure of 40 pounds (PSI) during spraying operation to assure uniform flow and proper functioning of the nozzles and to produce small droplets (100-120 microns). The number of nozzles varied based on the type and speed of the aircraft. Swath width of the application ranged from 75 to 90 feet, also depending on the type of aircraft. Types of aircraft included Cessna (300/310 HP), Ag-Cat (A&B&C Models, 450/600 HP), Ag-Cat (turbine), Thrush (600-1200 HP), Dromader (M18), Horton Brave (turbine), Air Tractor (301-401), and Weatherly (620). In order to minimize the possibility of drift and deliver high quality application, airplanes flew as close to the crop canopy as possible (no higher than 5 feet above the canopy unless obstructed by infield permanent fixtures).

Each aircraft was equipped with a differentially corrected Global Positioning System (GPS) unit. This technology is similar to the one used in mapping, and is used in the aerial application as a method of quality control and documentation. At the end of each day, the aerial contractor provided program personnel (Field Supervisor) with information for each flight on a standard 3.5" high density computer diskette or on a Memory Card (PCMCIA SRAM). The field supervisor then displayed every flight on a computer screen to verify the quality of application by examining the exact position of aircraft, flight pattern, time and date of application, speed, swath width, spray on/off, and flight time for each field as well as total flight time for each airplane. Three different GPS systems were utilized in the aerial applications during the 1994 and 1995 spray operations, including Satloc MapStar version 2.08, Del-Norte (Landnav®) and Precision Electronic Guidance System (PEGS) version 1.6.

Fields that were located within close proximity to designated environ-mentally sensitive sites, i.e., schools, residences, child care centers, wildlife refuges, rivers, or fields with obstacles were treated with ground equipment. The high-clearance ground spray equipment (SPRA-COUPE) was used in all ground applications. Each SPRA-COUPE was equipped with a spray system to deliver a 1:1 mixture of malathion ULV and vegetable oil at a total volume of 32 oz/ac. A total of 18 specially designed brass nozzles, T-MIZER 2.4 (Bete-Fog Nozzle, Inc.), each connected to a 12VDC metering pump (Fluid Metering Inc.), were evenly installed for broadcasting application on a 60-foot hydraulically controlled boom mounted at the rear. Boom height was adjusted to 6 inches above the cotton canopy during spraying to deliver an even pattern of application, and to minimize the potential for chemical drift.

Mist blowers (Automatic Equipment Co.) were mounted on the chassis of 3/4 ton, 4 x 4 pickup truck. These provided accurate placement of insecticide on corners and edges of fields and under power lines or other obstacles where airplanes had less accessibility. With 20 pounds (PSI) pressure generated by a four-roller pump (Hydro Inc.), driven by an18 HP engine, a single stainless steel(8001)flat fan, T-jet nozzle mounted on a single delivery point of the air blast discharge (at a speed of 10 MPH) under optimum conditions, effectively covered a 50-foot swath with 16 oz/ac of malathion ULV.

Evaluation

Further evaluation was conducted in an effort to compare the boll weevil population densities in the SRP zone (active program), with the contiguous CRP and St.L zones (currently not under eradication). The nearest cotton in the CRP and St.L to the SRP is a distance of approximately 10 and 40 miles, respectively.

Twelve cotton fields were randomly selected in each of the SRP, St.L and CRP zones. All fields in the SRP were under boll weevil eradication pro-gram control, while those in the St.L and CRP were under individual grower control. Nine fields were dryland and three were irrigated in both the SRP and CRP zones, while two fields were dryland and 10 were irrigated in the St.L zone. Fifty green, hostable bolls were collected randomly from each of the northeast, northwest, southwest and southeast quadrants of each of the fields.

Boll samples were taken on October 11 in the St.L, on October 12 in the SRP, and on October 18, 1995 in the CRP. Beginning at a distance of approximately 50 feet from the field edge, a large circular pattern was followed in taking each sample, utilizing as much of the area in the quadrant as possible. Bolls were taken to the laboratory in paper bags within five to six hours after collection. The following morning the bolls were opened, examined and all life stages of boll weevil were identified, counted and recorded. All statistical analyses were carried out using “ANOVA” and “RANGE” tests, MSTAT-C statistical software programs (Michigan State University, Copyright 1988).

Data management

Due to the massive amount of data being collected, sorted and tabulated on a daily basis, it was imperative that a sound computer program and data management system be developed. Three main databases were developed using Novell- Betrieve (Novell, Inc.) and TAS PRO version 4.0 (Business Tools Software, Inc.) to manage program data. These databases included the Field Information, Trapping Information and Treatment Decision. Field Information consisted of field number, trap number, number of traps around each field, number of acres in each field, grower’s field number, grower’s name and phone number. Trapping Information included the field number, number of weevils captured in each trap, date(s) of inspection, crop phenology in each field at each inspection and the trapper identification number. The Treatment Decision database was a combination of the other databases to enable program personnel to make treatment decisions based on the criteria described previously (action threshold and crop phenology). Field information was entered into the main computer at the field offices at the beginning of the season. Trapping information was entered on a daily basis. Each field office was capable of managing approximately 100,000 acres of cotton. Trapping information was then compared with the field information database to detect missing or mislabeled information. Each field supervisor used a 386, 66 MHZ (PC) computer that is connected to the main computer (486, 100 MHZ) via a 10-user network (Novell Group Ware).

Results

In the SRP, preliminary analyses indicate that the overall mean number of adult weevils captured per trap during the fall (September 10 to November 19) of 1995 was significantly less than the fall of 1994. The 1995 mean was 2.7 and the 1994 mean was 50.6, a reduction rate of 94.7%. (Figure 2)

The overall mean number of boll weevil larvae per 50 bolls found in the 2400 bolls collected from the 12 randomly selected fields was 0.79, 7.19, and 17.92 in the SRP zone, St.L and CRP respectivly. SRP was significantly less, LSD = 2.43. The overall mean number of boll weevil pupae per 50 bolls found in the 2400 bolls collected from the 12 randomly selected fields was 0.00, 3.021, and 5.90 in the SRP, St.L and CRP, respectively, LSD = 1.199. The overall mean number of boll weevil adults per 50 bolls found in the 2400 bolls collected from the 12 randomly selected fields was 0.00, 2.38, and 3.4 in the SRP, St.L, and CRP, respectively, LSD = 1.165. (Table 1).

Based on the above, we conclude that the outcome of the first year of the area-wide boll weevil eradication program in the Southern Rolling Plains was favorable and the boll weevil numbers were significantly reduced. In the LRGV, there was no program trapping data collected from the previous year for comparison as there was in the SRP. In 1995 (first year of the program), the overall mean number of boll weevil adults per trap during the month of August (peak fall populations), was higher than the overall mean number of boll weevil adults per trap during the month of April (peak emergence of overwintering populations) by 8-fold (Figure 3). Typical population trends under individual grower control in the southern part of Texas ranged between 20- to 80-fold increase when the same type of analysis was applied (Segers et al., 1987), (Wolfenbarger et al., 1976),and (Guerra et al., 1982). A definite conclusion may not be made until comparative data is collected in 1996.

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Table 1: Overall mean number of boll weevil larvae, pupae, and adults, Texas, 1995.

Treatment[a]	$\bar{x}$ Larvae/50 bolls[b]	$\bar{x}$ Pupae/50 bolls	$\bar{x}$ Adults/50 bolls
SRP	**0.79 c**	**0.00**	**0.00**
St.L	**7.19 b**	**3.02 b**	**2.38 a**
CRP	**17.92 a**	**5.90 a**	**3.46 a**
LSD 0.05	**2.43**	**1.20**	**1.17**

[a]Treatment: (SRP) Southern Rolling Plains, (St.L) St. Lawrence, (CRP) Central Rolling Plains.
[b]Means in a column not followed by the same letter differ significantly at $P \leq 0.05$ as judged by RANGE test.

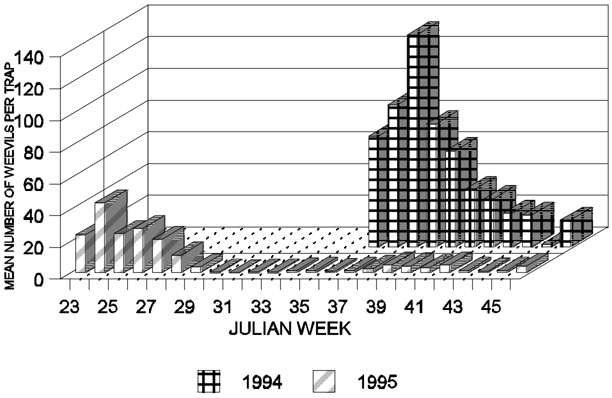

Figure 2: Mean number of weevils per trap during 1994 and 1995 in the Southern Rolling Plains, Texas.

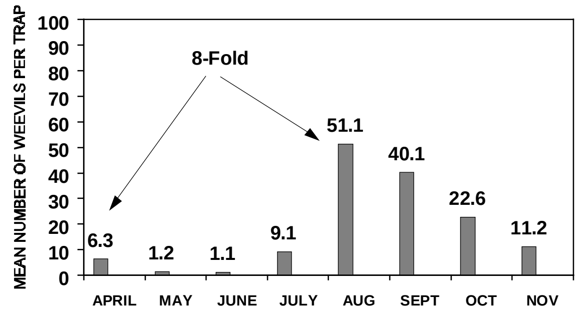

Figure 3: Mean number of weevils captured per trap per month in the Lower Rio Grande Valley, Texas, 1995. (uunder area-wide program control)