
GRANDLURE: USE IN BOLL WEEVIL CONTROL AND ERADICATION PROGRAMS IN THE UNITED STATES

W. A. Dickerson
Boll Weevil Eradication Research Unit
Agricultural Research Service
U. S. Department of Agriculture
4116 Roedy Creek Road
Raleigh, North Carolina 27607

ABSTRACT

The grandlure-baited boll weevil trap is an essential component of most, if not all, boll weevil control programs. While there are other minor uses of grandlure, the major use is as an attractant for the boll weevil trap. The Southeastern Boll Weevil Eradication Program uses the grandlure-baited boll weevil trap to determine areawide distribution of boll weevils, field-by-field presence of boll weevils, where and when to apply insecticide treatments and suppress very low populations of boll weevils.
Female boll weevils, *Anthonomus grandis* Boheman, were observed by Cross & Mitchell (1966) in a series of field tests conducted in 1963 to be attracted to male boll weevils at distances greater than 30 feet. Subsequent to these observations, Koller et al. (1964) reported that the male boll weevil emitted a substance which attracted the female boll weevil. Hardee et al. (1969) determined this male-produced pheromone attracted both male and female weevils in the spring and fall. Tumlinson et al. (1969) isolated, identified and synthesized the pheromone into four active components, two terpenoid alcohols and two aldehydes. These four synthesized components are referred to collectively as grandlure.

An effective grandlure-baited trap and dispensing system for grandlure have been under constant development for almost twenty years.

One of the keys to utilizing grandlure as a tool for boll weevil control is a dispensing system that provides controlled release of the pheromone over a protracted period. Early methods of dispensing grandlure employed by Tumlinson et al. (1969) included firebrick. This technique while providing an effective means for bioassay allowed the grandlure to be released within a few hours. Subsequent dispenser improvements by McKibben et al. (1971, 1980), Hardee et al. (1972, 1974, 1975), McKibben (1976) and Bull (1976) have led to the development of several efficient systems for releasing grandlure over a 1-4 week period.

Equally important to an efficient dispenser is an effective trap. Numerous early trap designs were evaluated by Cross et al. (1969). These field tests indicated a wing trap coated with a sticky material was the most effective design. However, traps developed later by Leggett & Cross (1971) and Mitchell & Hardee (1974) represented important steps in providing practical grandlure-baited boll weevil traps suitable for routine use. Essentially, the trap described by Mitchell & Hardee (1974) with modifications by Dickerson et al. (1981) and Dickerson (1985) has become the trap design in most common use.

The synthesis of grandlure and the development of an inexpensive and efficient trap and grandlure dispenser has led to the widespread use of grandlure-baited boll weevil traps. The use of grandlure as an attractant for traps is a vital part of essentially all boll weevil control programs in the U. S. today.

I will focus primarily on the use of grandlure in conjunction with boll weevil eradication in the southeastern U. S. However, before I discuss this aspect, I would like to briefly review two other uses of grandlure for boll weevil control.

1. **Pinhead square treatment:**

Cotton squares must be larger than pinhead stage in order to support boll weevil reproduction. Insecticides applied just prior to this critical stage of cotton growth will often eliminate most of the emerged overwintered weevils from the cotton field before reproduction can be initiated. Rummel et al. (1980) developed an index for assessing the need for chemical control during this time based on the number of weevils captured in grandlure-baited boll weevil traps during the 6-week period immediately prior to the pinhead square stage of cotton. Similar indexing systems are currently in use by most
boll weevil infested cotton producing areas of the U. S. Essentially, this principal of early season boll weevil control was proposed by Ewing & Parencia (1949) long before grandlure was discovered. However, the incorporation of the grandlure-baited boll weevil trap into their early season approach has greatly increased its impact on boll weevil control.

2. Modified trap crop:
The concentration of insects onto small plantings of preferred hosts has long been suggested as an efficient means to control insect pests. L. O. Howard (1896) suggested this trap crop approach for boll weevil shortly after this cotton pest was detected in Texas. Except for Isely (1924), relatively little additional research on trap crops was reported until Bradley (1967) found that periodic applications of insecticides to early planted border strips of cotton delayed subsequent infestations of boll weevil on nearby younger cotton. Research conducted by Lloyd et al. (1972) and Boyd (1973) indicated that the newly synthesized boll weevil pheromone, grandlure, could attract and concentrate weevils into small areas of a cotton field where limited amounts of chemicals could then be applied for their control. In this approach, grandlure is applied to a few rows of cotton adjacent to boll weevil hibernation sites. As weevils accumulate, insecticide treatments are applied to this limited area, thus preventing or reducing the need for subsequent field-wide treatment. This procedure essentially works in the same way as a conventional trap crop. Gilliland et al. (1976) reported that plantings of early fruiting cotton containing grandlure-bait stations were effective for suppressing emerging boll weevil populations.

Despite these encouraging reports, trap crops have received limited use and are not widely recommended as a means of early season weevil control. However refinements in this approach, including the use of grandlure, may result in renewed interest. Some current drawbacks to the use of grandlure in this system include the expense of the grandlure, critical timing of application, and the availability of a suitable grandlure formulation and dispenser system for this special use. Until these limiting factors are resolved, this potentially highly effective approach to boll weevil control will not be widely used.

3. Boll weevil eradication:
Boll weevil eradication was the expressed goal for the Boll Weevil Research Laboratory at the dedication of that facility in March of 1962. Eradication techniques developed there and in other Federal and State laboratories are currently being utilized by the Southeastern Boll Weevil Eradication Program. All cotton (over 200,000 acres) grown in Virginia, North Carolina, and South Carolina is included in this program. Grandlure-baited boll weevil traps are a key tool used to evaluate areawide and field-by-field populations of boll weevils over this 3-State area. This information allows the application of the most appropriate suppression measures to eradicate the boll weevil. The central role of the grandlure-baited boll weevil trap in the Southeastern Boll Weevil Eradication Program is well illustrated by listing yearly program activities for this 30-month program.

1983
• Map 1983 cotton fields.
• Place grandlure-baited boll weevil traps around cotton fields at 1 trap per 10 acres (July).
• Applications of insecticide for diapause control.

1984
• Place grandlure-baited boll weevil traps around the sites of 1983 cotton fields at 1 trap per acre (April).
• Map 1984 cotton fields.
• Place grandlure-baited boll weevil traps around 1984 cotton fields at 1 trap per acre (May).
• Application of insecticide at pinhead square stage of cotton.
• Application of insecticide for reproduction control.
• Application of insecticide for diapause control.

1985
• Place grandlure-baited boll weevil traps around the sites of 1984 cotton fields at 1 trap per acre (April).
• Map 1985 cotton fields.
• Place grandlure-baited boll weevil traps around 1985 cotton fields at 1 trap per acre (May).
• Application of insecticide at pinhead square stage of cotton.
• Application of insecticide for reproduction control.
• Application of insecticide for diapause control.

The integration of the biology of the boll weevil, phenology of the cotton plant, and program activities are illustrated in Figure 1. The eradication program was initiated in July of 1983 with areawide trapping followed by intensive applications of insecticide to prevent boll weevils from entering diapause. Limited trapping was continued throughout the winter to detect boll weevil movement during periods of warm weather. The intensive trapping of the previous years’ cotton field sites and current cotton plantings during the spring evaluate the need for insecticide applications at the pinhead square stage of cotton to prevent boll weevil reproduction. After cotton begins fruiting in late June and early July, grandlure-baited traps placed inside field margins and/or around field borders detect additional weevils entering the cotton fields from overwintering sites. Lloyd et al. (1983) reported that under conditions of low weevil populations, this intensive spring and early summer trapping is often sufficient to prevent weevil reproduction, thus eliminating the need for additional insecticide application. In late August and September as cotton stops fruiting, pheromone production by the boll weevil declines and the attractiveness of the grandlure-baited trap increases. During this period, the number of weevils captured in traps is a very sensitive indicator used to direct field-by-field insecticide treatments for diapause control. As boll weevil populations continue to decline during the course of the boll weevil eradication program, traps become increasingly efficient as the competing sources of pheromone become fewer and fewer.

The grandlure-baited boll weevil trap serves as the eyes and ears for managing the Southeastern Boll Weevil Eradication Program. The trap is the tool used to determine: (1) areawide distribution of boll weevils; (2) field-by-field presence of weevils; and (3) when and where to apply chemical treatment. Under conditions of very low weevil population, the trap may also provide significant suppression of emerging overwintered boll weevils. Eradicating the boll weevil from the southeastern U.S. would be very difficult, if not impossible, and certainly more costly, without grandlure and the boll weevil trap.

In 1985, the Southeastern Boll Weevil Eradication Program used over 400,000 boll weevil traps and approximately 2,750,000 dispensers containing 10 mg. of grandlure each. While the grandlure-baited boll weevil trap is not the only use for grandlure in boll weevil control programs, current and near future uses will likely center around trapping programs. I estimate that at least 99% of the grandlure produced in the U.S. is used as attractant in boll weevil traps.

References Cited

Bradley, J. R., Jr. 1967. Oriented movement of the boll weevil in response to trap
Fig. 1. The application of boll weevil eradication technology in relation to plant growth and the seasonal activity of the boll weevil.
crop plantings, foliage color, and sex pheromone. 73 pp. Ph.D Dissertation, Louisiana State University, Baton Rouge, LA.


USE OF PHEROMONES IN THE BOLL WEEVIL DETECTION AND CONTROL PROGRAM IN PARAGUAY

W. H. WHITCOMB
Professor Emeritus, University of Florida
Research Coordinator, Fito Technica Floricana, Inc.
P.O. Box 2458, Gainesville, FL 32601

AND

R. M. MARENGO
Ministry of Agriculture
Asuncion, Paraguay

ABSTRACT

Although the boll weevil, Anthonomus grandis Boem., arrived in South America before 1949, it was not discovered in Brazil until 1983. Now, however, the boll weevil is expected, momentarily, in neighboring Paraguay. A network of pheromone traps to intercept the boll weevil has been set up both on the Paraguay/Brazil border and in important cotton producing areas of Paraguay.

RESUMEN

Aunque el picudo Mexicano, Anthonomus grandis Boem., llegó a Sudamérica antes de 1949, no fue descubierto en Brasil sino hasta 1983. Ahora, no obstante, se espera que el picudo Mexicano llegue al Paraguay muy pronto. Una serie de trampas de feromona para interceptar el picudo se han colocado en la frontera de Paraguay/Brasil y en las zonas importantes de producción de algodón en Paraguay.

The cotton boll weevil, Anthonomus grandis Boheman, a pest of North American cotton for over 50 years, was discovered in South America on 20 Nov. 1949. Specimens taken at Tachira, 20 km south of Maracay, Venezuela, were found to be A. grandis (Ron-Pedrique 1950, Whitcomb 1962, Whitcomb & Britton 1953). The identification was confirmed on 30 Nov. 1949 by C. F. W. Muesebeck from specimens forwarded to Washington, D.C., U.S.A. Final determination was made by L. L. Buchanan from dissections of the genitalia.

Serious yield losses were reported by cotton growers all over Venezuela. The economic impact was severe. By 1960, the Atlantic coast of Colombia was heavily infested.

For over 30 years, no other South American countries reported new boll weevil infestations. However, in Feb. 1983 the boll weevil was discovered near Sao Paulo,