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A Bibliography of the Pink Bollworm, *Pectinophora gossypiella* (Saunders)

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Abstract

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The pink bollworm, *Pectinophora gossypiella* (Saunders), was described by W.W. Saunders in 1843 as *Depressaria gossypiella* from specimens found to be damaging cotton in India. Infestations in the United States first occurred in Texas cotton in 1917. At present, the pink bollworm has been recorded in nearly all cotton-growing countries of the world and is a key pest in many of these areas. Existing tactics for achieving a high degree of suppression of established pink bollworm populations are well advanced and feasible on a field-by-field basis. A combination of tactics may achieve even higher levels of pest suppression if implemented on an areawide basis. The longstanding nature of the pink bollworm problem in many areas of the world and the likely development of areawide management programs in the future prompted us to develop this bibliography as an information base to assist those in program planning, implementation, and evaluation. The bibliography should also be a useful aid to researchers, educators, extension personnel, agricultural producers, industry, and government administrators involved in managing this serious pest.

While supplies last, single copies of this publication may be obtained at no cost from Steven E. Naranjo, USDA–ARS–PWA, 4135 East Broadway Rd., Phoenix, AZ 85040–8803.

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Introduction

The pink bollworm, *Pectinophora gossypiella* (Saunders), was described by W.W. Saunders in 1843 as *Depressaria gossypiella* from specimens found to be damaging cotton in India in 1842 (Ingram 1994). The insect has been taxonomically designated under several other generic names, and the complete synonymy was reported by Common (1958). The origin of pink bollworm remains unknown but the diversity of parasite species found in Pakistan (Cheema et al. 1980) appears to support an Indo-Pakistan origin (Ingram 1994). It has also been suggested that its origin occurred in the area of the eastern Indian Ocean bordered on the east by northwestern Australia and on the west by the various islands of Indonesia-Malaysia (Common 1958). However, Wilson (1972) suggested that the pink bollworm may have been introduced into Australia in cotton seed. Pearson (1958) documents spread of the pink bollworm Sri Lanka, Burma, and Malaysia (Lefroy 1906) and China before 1918 (Hunter 1918).

The pink bollworm was first recorded in Australia in 1911 (Wilson 1972). The first records from the African continent were in Tanzania (Vosseler 1904), Egypt about 1906–1907 (Willcocks 1916), and Sudan in 1914–1915 (Ripper and George 1965). The insect did not reach Malawi until 1939 (Smee 1940), and it appeared in Zimbabwe as late as 1959 (Whellan 1960).

It was introduced into the Western Hemisphere between 1911 and 1913 in cottonseed shipped from Egypt to Brazil, Mexico, the West Indies, and the Philippine Islands (U.S. Department of Agriculture 1977). Spread in the New World started in Hawaii, where it was imported from India in cotton seed (Fullaway 1909). From Hawaii it spread to St. Croix in 1911 (Hunter 1918).

Infestations in the United States first occurred in Texas cotton in 1917. The source was traced to cottonseed shipped from Mexico to Texas oil mills in 1916 (Spears 1968, U.S. Department of Agriculture 1977). Cotton-free zones and extensive cleanup measures eliminated the Texas infestation, as well as an infestation found in Louisiana in 1919.

Pink bollworm was eradicated from cultivated cotton in parts of Florida and Georgia in 1932, but it still exists in wild cotton and backyard cotton in southern Florida. Reinvasions in Texas in 1936 occurred in the lower Rio Grande Valley, probably from windborne moths from Mexico, and eventually spread by the mid-1950s to other areas in Texas, New Mexico, Oklahoma, Arizona, Arkansas, and Louisiana. Infestations in eastern Arizona were reported in 1926 and at intervals thereafter in other parts of the state. These infestations were suppressed through cooperative Federal, State, and industry programs. Termination of these efforts in 1963 resulted in spread to the Imperial and Palo Verde Valleys of California in 1965. Severe losses had occurred by 1967 in southern California cotton production areas. Moths were detected in the high desert areas of Los Angeles and San Bernardino Counties in early 1967, and moths and larvae were found in cotton in the San Joaquin Valley near Bakersfield later that year. Native moths have been trapped in the San Joaquin Valley each year since, except for 1968, and a few larvae have also been found some years.

As of this writing, the San Joaquin Valley remains the only cotton-growing area in Arizona and California that does not have a firmly established pink bollworm population. This fact is partially explained by extensive cultural control, pheromone monitoring, and a sterile-moth release system initiated in 1968 (see Henneberry 1994 for a review of this system). Other factors, such as differences in environmental conditions, suggest that even if pink bollworms were established there, generations would be fewer and population levels would be lower compared with the lower desert cotton-growing areas of the far west. The effect of the region's climate on the pink bollworm is an unknown in this circumstance.

The pink bollworm is now recorded in nearly all the cotton-growing countries of the world (CAB Institute of Entomology 1990), and is a key pest in many of these areas. The only major cotton-growing countries where pink bollworm is still absent appear to be Russia, Central America (Belize, Costa Rica, Guatemala, Honduras, Nicaragua, and Salvador), parts of South America (Ecuador, Guyana, and Surinam), and Queensland, Australia (Ingram 1994).

Existing tactics for achieving a high degree of suppression of established native pink bollworm

populations on a field-by-field basis are well advanced (Henneberry and Naranjo 1998) and feasible. A combination of tactics may achieve even higher levels of pest suppression if implemented on an areawide basis. The components of such an areawide management program must be carefully selected to ensure compatibility. Because of the broad geographical areas involved in cotton production, many different environmental, agricultural, and social communities are involved. Population densities of pink bollworm vary considerably between areas, moth dispersal over hundreds of miles has been demonstrated, and cotton production practices and cotton cultivars grown vary considerably. These factors combined suggest that a single type of standard pink bollworm management program would not be applicable to all growing areas. All management tactics would not be needed in every production area; rather, programs tailor-made for specific cotton production areas may be the most viable option. Identification of tactics that are compatible and feasible will require expertise from many areas of the agricultural community. Crop scientists and entomologists working with cooperative extension, growers, pest control advisers, state departments of agriculture, the agricultural chemical industry, and cotton commodity support groups must combine their efforts in all stages of planning, implementation, and assessment.

Development of areawide pink bollworm management programs in the near future is a highly desirable option. The high probability of this occurring prompted us to develop this bibliography as an information base to assist those in the planning, implementation, and evaluation stages. The bibliography should also be a useful aid to researchers, educators, extension personnel, agricultural producers, industry, and government administrators involved in managing this serious pest.

This bibliography attempts to compile the world literature of *P. gossypiella* since the original description by Saunders in 1843. The bibliography was derived from a number of sources, including the personal reprint collections and databases of the authors, the unpublished manuscripts of Harned (1952) and Gordh (1988), and the published reviews of Noble (1965), Ingram (1994), and Henneberry and Naranjo (1998). The Current Awareness Literature Service of the National Agricultural Library (NAL) was also helpful in conducting searches of various abstracting databases, such as AGRICOLA (NAL), AGRIS (United Nations, Food & Agriculture Organization), Biological Abstracts (BIOSIS), Commonwealth Agricultural Bureaux Abstracts (CABI), Zoological Records (BIOSIS), Current Contents (Institute for Scientific Information), and Dissertation Abstracts International (University Microfilms International).

The bibliography includes scientific journal articles, scientific books, proceedings of symposia, conferences and workshops, local, regional and national reports and technical bulletins, and popular, special interest and trade press. Coverage of some of these latter categories may not be as complete as for journal articles and books because of variability in coverage of the abstracting services and variation in our knowledge of and access to titles from proceedings, reports, technical bulletins, and popular press sources from throughout the world. We have spelled out journal and other source names in full whenever possible; however, to conserve space we have used initials for first and middle names of authors even when full names may appear in the actual article.

Final literature searches for this bibliography were completed on May 20, 2002. Electronic copies of this bibliography and annual addenda may be downloaded free of charge from the World Wide Web at http://www.wcrl.ars.usda.gov/biblios/pbw/pbwbiblios.html.

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