Early season pink bollworm pheromone mass trapping has been used on approximately 18,000 acres of Arizona cotton every year since 1976. Research to evaluate the effects of pheromone mass trapping of pink bollworm male moths has resulted in data showing consistently lower infestations in mass trapped cotton when compared to untrapped cotton.

The following table summarizes the results of the 1980 research in the Safford and Wenden areas.

Comparative % Pink Bollworm Infestations in Pheromone Mass Trapped and Untrapped Long Staple Cotton in 1980. *

Type of Sample	Safford Area		Wenden Area	
	Mass Trapped	Untrapped	Mass Trapped	Untrapped
Green Bolls	15.3	48.1	16.9	23.3
Open Bolls	9.7	34.6	5.8	13.2
Open Bolls with Multiple Infestation	0.7	9.0	0.5	1.4

* Based on whole plant samples collected during late October prior to harvest. Total bolls dissected: Safford = 3,700; Wenden = 2,400.

Some Guidelines for Use of Gossyplure in Pink Bollworm Control

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I. Criteria for Selecting Candidate Fields.

The successful use of gossyplure by the mating disruption method depends on the grower and pest control advisor being thoroughly familiar with the unique characteristics, requirements, and limitations of this control technique. Field personnel must carefully and frequently check pheromone traps and take boll samples to determine the effectiveness of the pheromone applications.

A low overwintering population is important for mating disruption, as with any other control program. Low overwintering populations are obtained by early termination of the crop the previous season, early harvesting, disposal of stalks by shredding followed by deep plowing and winter irrigation to aid decomposition of plant wastes, and the growing of a small grain crop following cotton.

Since pheromones do not kill moths, it is important that mated female moths not migrate into gossyplure treated fields. Isolation of treated fields is desirable, with at least 1/4 to 1/2 mile from the nearest stub field, partly to reduce the migration of other pests such as cottonleaf perforator. An ideal way to provide isolation is to treat large areas with gossyplure.

II. Program.

1. Determination of Initial Application.

Emergence of adult pink bollworms from overwintering larvae is affected largely by temperature and moisture. In central and western Arizona emergence begins in early to late March and continues into July, with the peak in April and early May. Generally a substantial portion of the moths emerge prior to the appearance of squares (buds) in planted cotton. This suicidal emergence does not contribute to infestations.

The timing of the first application is made at the time or shortly before plants produce the first squares, as per label directions. This is most important in early planted fields or in fields in which high overwintering populations may be present. In fields with few pink bollworms, the first pheromone application may be delayed after the first squares but no later than one week after the appearance of the first flowers. Dates of squaring and flowering can be predicted by the use of heat units calculated from the daily maximum and minimum temperatures.

Gossyplure-baited traps are used to determine the abundance of moths. Traps should be set out soon after planting, especially if plans include a delay of the initial application after the appearance of the first flowers, traps must be adjusted to the top of the plants, replaced when dirty, contain an effective bait, and be checked frequently. If a large number of moths are trapped during the period of squaring, pheromone applications should be considered.

2. Frequency of application.

Frequency of gossyplure applications is determined by air temperature because gossyplure is lost through evaporation. Early in the season when daily field temperatures do not exceed 100'F (38'C) the longevity of commercial treatments is approximately 21 days. Later in the season when daily field temperatures are greater than 100'F, a gossyplure application may be effective for only 10 to 14 days. Heavy rain or high winds may affect the longevity of a treatment by knocking the fibers or flakes off the plants. Rapid plant growth may also require more frequent applications.

3. Ammendments or Termination.

A. Monitoring Methods.

1). Boll Sampling. The best sampling method to determine the effectiveness of a pink bollworm control program is to cut 15-20 day-old bolls for larvae at least at weekly intervals. Bolls should be collected so that they represent a sample of the whole field or a particular portion of it. The sample size should vary depending on the size of the field. Larger fields should have a proportionately larger number of samples taken. Boll samples should be only slightly spongy to a firm press between thumb and fingers, that is,15 to 20 day-old bolls. Warts or mines on the inner carpel walls also indicate the presence of larvae. If the population of small larvae in bolls approaches the local economic threshold, consideration should be given to termination of the pheromone suppression program since the number of gravid females in the field may have increased by immigration or as a resident population and be capable of causing economic crop damage. Such evidence of a breakdown should be verified from additional samples taken throughout the field, as only some of the edges may be infested. The appearance of only large larvae and/or exit holes in the bolls reflect previous adult activity of up to two weeks. Action against this population should be directed toward the future adults that will emerge in approximately one week.

2). Traps. Gossyplure-baited traps are used to monitor the effectiveness of pheromone treatments by capturing male pink bollworm moths but should not be relied upon as a sole method of monitoring. Relatively high moth captures soon after an application may indicate poor coverage or other treatment problems. If numbers of males increase after suppression, it may indicate that the effect of the pheromone is wearing off and that it is time to make another application at once. Some moths will be caught occasionally in traps in effectively treated fields. Even with the absence of moths in traps, boll samples must be made.

Traps should also be placed in non-pheromone fields in the general area and monitored in the same manner as those in the pheromone fields. These traps will provide an idea of the population size and its fluctuation, although the counts may often be affected by insecticide applications to the fields.

B. Insecticide Applications for Pink Bollworm in Pheromone Programs.

If boll samples and trap counts indicate the presence of pink bollworm populations along the edges of blocks or in hot spots in pheromone fields, treatments by certain pesticides may be used without destroying beneficial insect populations. Such treatments will kill any remaining pink bollworm moths, although most of the moths that laid eggs in the bolls of the samples will have already died. Continuation of the pheromone program will prevent the moths from the next generation from becoming mated when they emerge.

4. Treatments Used for Other Pests.

The increased activity of insect predators and parasites, as a benefit of a gossyplure program, should help to reduce the numbers of other harmful insects and generally reduce the need for their treatment. The indirect costs of conventional insecticide programs such as reducing populations of insect parasites, predators and pollinators, increasing mite egg laying, causing phytotoxic effects and crop delay, generally should raise the economic threshold for other insect pests. The aggresive monitoring program required by the gossyplure program assures that fieldmen will be closely watching the crop. They should, however, develop a more tolerant attitude toward the presence of secondary pests to foster natural control by parasites and predators.

The treatments used for other pests should do as little harm to beneficial insects as possible. Temik for the control of cotton leafperforator and lygus bugs might be considered. Bacillus thuringensis with a feeding stimulant has shown promise for bollworm, tobacco budworm and cabbage looper control. Insecticides should be selected and dosages used that are least harmful to beneficial insects. They should be applied at night to get maximum effect against night-flying moths and minimize their effect upon day-flying pollinators.

5. Costs.

A treatment of gossyplure in 1980 cost approximately $5.50 per acre for material and $3.00 for application. The seven conventional insecticides recommended for pink bollworm control cost an average of $6.24 per acre with an application cost of $3.50 per acre.

Ten fields at Parker, AZ receiving gossyplure treatments in June and July, 1980, had lower pink bollworm populations in pheromone traps during August and September and required fewer insecticide applications during August than 10 fields not treatred with pheromones on the same ranch. The average total cost for treatments in gossyplure-treated fields was $81.17 per acre. The ten fields with conventional insecticides had an average total cost of $93.54 per acre. Growers that have used gossyplure treatments for several years report having smaller pink bollworm populations each year. A major reduction in energy use is obtained with gossyplure treatments, as a plane load of gossyplure is much lighter, can fly at a safe 50-ft altitude, and can treat 8 times more acreage than an airplane with conventional insecticides flying at the tops of the plants.

III. Advantages and Disadvantages.

A. Advantages.

1. A gossyplure program substantially suppresses the early generations of pink bollworms and delays or eliminates the need for insecticide control in June and July and may reduce use in August and September. It also reduces the size of the late season generations which enter diapause to inititate the following season's infestation potential.

2. The use of gossyplure to control pink bollworms as an alternative to conventional insecticides reduces chemical stress on the environment. Avoiding repeated applications of effective insecticides reduces the rapidity with which tolerance and/or resistance develops in other cotton insect pests such as the tobacco budworm. Use of gossyplure should lengthen the effective life of our remaining insecticides.

3. In many areas of the desert, pink bollworm is the first major pest species which requires control in planted cotton. Repeated insecticide applications reduce or eliminate important insect predators and parasites of other pests and which results in a 'treadmill' or reliance on insecticides throughout the season. A gossyplure suppression program not only reduces pink bollworm larval infestations but also allows beneficial insects to exert natural controls on other pest species and permits activity of pollinators.

4. Gossyplure is not phytotoxic and causes no delay in crop maturity.

5. Gossyplure is a naturally occurring material and is non-toxic to users and field workers. There is no re-entry interval and special safety equipment or protective clothing is not required. Social liability is reduced in urban areas.

6. Gossyplure is cost competitive with conventional insecticides.

7. Gossyplure is a more energy efficient pest management system due to the reduced amount of flying and nurse trucks are not needed.

B. Disadvantages.

1. A thorough knowledge of field conditions and close monitoring of their changes by the pest control advisor requires more time than that for conventional insecticides.

2. A gossyplure program is based on the suppression of the pink bollworm population before it reaches an economic threshold while insecticide control programs kill a population after the economic threshold has been reached. These opposite premises are confusing to the user but must be understood.

3. Commercial applications of gossyplure currently require special application equipment.

4. Gossyplure is specific just to pink bollworms and insecticides may be required to treat other pest species.

5. Gossyplure is odorless, does not kill moths, and fibers or flakes are difficult to locate in the field so its presence or absence is difficult to observe directly. It does not kill pink bollworm moths and male moths cannot locate traps so detection of the presence or of the fluctuations of pink bollworm adult populations after treatment is difficult to assess. For this reason, check fields are desirable..

6. Our knowledge of the basic behavior of pink bollworms is incomplete and this contributes an air of mystique to the program.