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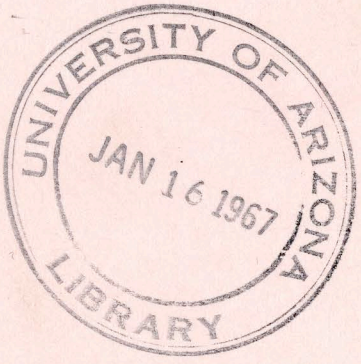
A Summary Report of

PINK BOLLWORM RESEARCH

in 1965



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A Summary Report of Pink Bollworm Research in 1965[1/] [2/]

George P. Wene and L. W. Sheets[3/]

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Introduction

Populations of the pink bollworm, Pectinophora gossypialla (Saunders) increased greatly in Arizona during 1965. Infestations were widespread in Graham, Pinal and Maricopa counties, with economic damage occurring in a number of fields in each of these counties. In addition, non-economic infestations were found for the first time in Yuma County. These latter infestations probably developed from moths migrating westward from heavily-infested fields of "stub" cotton in western Maricopa County.

Reduction of Adult Emergence in the Spring

Burial of bolls by plowing under crop residues to a depth of 6 inches has been one of the recommended practices for reducing of the spring emergence of overwintering pink bollworms. Previous work in Arizona, especially in winters of low rainfall, has shown that burial of bolls to a depth of 6 inches does not provide adequate reduction of overwintering larvae as measured by spring moth emergence (Wene et al. 1965). Experiments were conducted in 1964-65 to determine the effect of burying infested bolls to a depth of 12 inches.

Emergence cages of the type described by Wene et al. (1965) were used at Safford and Phoenix. At each location 350 infested unopened (hard) bolls of long staple cotton were placed in each cage under the conditions shown in Table 1. Individual cage treatments were replicated 4 times at Safford and 5 times at Phoenix. The bolls were buried at Safford on November 27, and those at Phoenix on December 19, 1964. The cages in which barley was planted at Safford received three irrigations at 10 day intervals beginning at the time the bolls were placed in the emergence cages. The similar cages at Phoenix received only one irrigation when the experiment began. Light, intermittent rains which fell during the next month provided sufficient moisture to keep the barley growing satisfactorily without further irrigations.

Under natural rainfall at both areas the best reduction of spring adult emergence was obtained when the bolls were buried to a depth of 12 inches. The results obtained from bolls buried to a depth of 6 inches in the two areas confirm previous unsatisfactory results (Wene et al. 1965). Therefore burial of bolls to a depth of 6 inches cannot be relied on to give adequate reduction of spring emerging adults.

At Safford good reduction was obtained when the cages in which barley was planted were irrigated three times. Similar cages at Phoenix were irrigated only once and the natural rainfall, although sufficient to provide moisture for good barley growth, did not saturate the soil for as long a period as the three irrigations at Safford. The spring moth emergence at Phoenix was therefore not reduced to the low levels observed at Safford. These data confirm previous observations that moisture is a factor when buried, infested bolls are buried and subjected to prolonged periods of excessive soil moisture (muddy soils) during cold weather.

Diapause Studies

In the fall fully developed larvae enter a dormant stage called diapause. The larvae pass the winter in this stage either in the seed of a cotton boll or in the soil within a cocoon. An experiment was conducted to determine whether the common belief that all larvae go into diapause by October 1 is valid.

From September to November 1965 fully developed pink bollworm larvae were taken from unopened cotton bolls at Solomon (Graham County) and Rainbow Valley (Maricopa County) (Table 2). From 10 to 15 larvae were placed in each of a series of petri dishes for observation. The bottom of each dish was covered with a piece of white filter paper and water was added as needed to provide humidity. Within hours, all larvae had enclosed themselves in cocoons firmly attached to the filter paper. These larvae were observed for three weeks. Usually within

seven days non-diapausing larvae pupated, while diapausing-larvae remained in a quiescent state within the cocoon.

Results in Table 2 show that in the tests at Safford and Phoenix very few larvae entered diapause before late September. By October 5, 97% of the larvae collected from hard bolls at Solomon were in diapause. By October 15, all bolls which were classified as hard on October 5 in the field at Solomon had opened and additional larvae were then collected from half grown soft bolls on tops of plants in the same field. Only 67% of these larvae were in diapause. Eleven days later these bolls, although small, had hardened and the percentage of diapausing larvae had increased to 93. These data, although limited, suggest that condition of the boll as well as time of year may induce pink bollworm larvae to enter diapause.

It is significant that approximately the same percentage of the larvae from both areas became adults instead of diapausing in October. In 1965, larval populations were extremely high in a number of fields in the Salt River Valley; thus if even 8% of these larvae became adults they could heavily infest the late top crop developing during October and November. In mid-November only first and second instar larvae were present in numerous fields near Mesa indicating recent pink bollworm moth activity. Therefore the practice of trying to produce a late top crop could result in higher fall and winter larval populations and higher spring moth emergence.

Fall Adult Emergence Studies

Late fall moth emergence of the pink bollworm moths has been considered unimportant by some observers. However, this late emergence determines the number of larvae developing and diapausing in the late or top crop and, in turn, influences the number of adults emerging the following spring especially when winter mortality is low. Observations in Graham County from 1959 to 1963 showed that populations of one to three pink bollworm larvae per boll could be found in infested fields

by early October. By the end of October, the population in these bolls had declined to less than one larva per 4 or 5 bolls. By the middle of November, however, populations as high as 2 to 3 larvae in all instars per boll could be found in all instars of growth. The abundance of young larvae of a new generation suggested that these infestations resulted from oviposition during the latter part of October and early November, a period commonly considered unfavorable for adult activity.

Field Emergence Studies - On September 14 at Solomon (Graham County) twelve emergence cages, each 36 square feet and 5 feet high, were placed over plants in a field heavily infested with pink bollworms. One half of the field containing 6 emergence cages was sprayed as indicated in Table 3 to keep pink bollworms from infesting the top crop. Emergence records were taken daily until November 1 when the cages were moved to permit harvest.

The numbers of moths emerging between September 15 and November 1 are shown in Table 3 with the daily emergence records being grouped on a weekly basis. The untreated cotton was taller than that sprayed with insecticides and was therefore more attractive for oviposition. This may partly account for the differences in adult emergence between the two areas during the first two weeks of observation. Table 3 shows that in a six-week period (September 15 to November 1) a total of 70,269 adults per acre emerged in the untreated portion and 39,715 adults emerged in the treated portion of the field. (Some recently emerged adults probably had been killed by insecticides.) The highest emergence in a single day was 7 per cage, equal to 5,647 adults per acre. Table 3 shows that heavy emergence continued until October 14. The decline in emergence after October 14 at Solomon was due to lower temperatures. Other observations showed that emergence at Phoenix, with warmer weather, continued high until affected by low temperatures in mid-November.

Moths emerged from the untreated portion of the Solomon field at the rate of about 25,000 per acre during October. Since these adults emerged from a population in which approximately 90% of the larvae were in diapause (Table 2), about 250,000 diapausing larvae per acre must have remained to overwinter in this field.

Cage Emergence Studies - Bolls from pink bollworm infested fields in Graham and Maricopa counties were collected at various times in the fall of 1965 for cage studies of the intensity and duration of fall emergence (Table 4). An average of 350 long staple bolls were placed in each cage except in text No. 6 where 200 bolls of short staple cotton were used. A single emergence cage was considered as a replicate. Tests 1, 3, 4, 5, 7 and 8 were replicated four times, while tests 2 and 6 were replicated only twice.

These data show that late fall emergence of pink bollworm adults is relatively high during warm weather and decreases as the weather becomes cooler. After mid-October, Graham County is much cooler than the Salt River Valley, and the data show that the average weekly adult emergence was less. Near Phoenix, with an average temperature about 10° warmer emergence was observed until December 1. These data show that heavy infestations can develop late in the year in the lower elevations. This was confirmed by observations on November 13 which showed numerous first instar larvae in immature bolls. Many of these immature bolls contained one first or second instar larva, indicating that late developing bolls can increase the winter carry-over of pink bollworms.

In tests 2 and 5, immature bolls which had hardened contained larvae in only the first or second instars of growth. Some of these larvae developed to maturity even when the bolls were removed from the plants and placed on the soil surface when decay was minimized. This emphasizes the importance of destroying immature bolls with a good stalk cutter and with early burial to a depth of 12 inches.

Control with Insecticides

On September 14 a field near Solomon had an estimated population of 2 or 3 pink bollworms per newly-hardened boll, although none were found in the soft bolls. Half of this field was sprayed with an insecticide on the dates shown in Table 5. On October 27, two days after the final insecticide application 100 unopened bolls were collected from 5 points in the treated and untreated areas. These bolls represented the top crop and were small and soft at the time of the first insecticide application. The bolls were carefully examined for the presence of larvae and exit holes. An exit hole was considered as a pink bollworm larva. This experiment was conducted in the same field with the adult emergence studies. An infestation was therefore assured (Table 3).

Insecticides reduced the larval population from 2.04 larvae per untreated boll to 0.37 larvae per treated boll (Table 5). Such treatments should effectively reduce the numbers of larvae entering diapause. This work again emphasizes that pink bollworm infestations can develop after mid-September, and that late cotton crops are extremely favorable for development and survival of pink bollworm population.

Relationship of Cotton Plant Growth to Pink Bollworm Infestations

Graham County: In recent years 35 to 50% of the total acreage has been planted to the long staple varieties Pima S-1 or S-2. Since 1958, however, all but one of the high pink bollworm infestations in this County occurred on long staple varieties.

The upland variety commonly grown is Acala 1517D. It is more determinate in growth than Pima. When planted before May 1, it will set most of its squares during June and July with fruiting tapering off in August. During early September this variety will "cut out," the bolls will mature rapidly and the plants will not make further top growth. By mid-September, the bolls are hard, almost

mature, and not suited for entrance of pink bollworms. A few of the nearly mature bolls may be infested but they are usually too few to be of concern and very little damage is done. Acala (upland) bolls are large and, when compared with a Pima boll, a single larva does proportionately less damage.

A field of Acala planted about May 20 was the only cotton of this variety to be severely damaged by the pink bollworm in 1965. Because of the lateness of the crop, the grower irrigated heavily and often during September. As a result the bolls continued to be soft on October 1, and attracted the large pink bollworm moth populations which had emerged in other fields during late September. The plants were lush compared with those in adjacent fields which had matured earlier and where few pink bollworm larvae could be found. This indicated that pink bollworm adults can migrate in destructive numbers from one field to another. This was the first year the field was planted to cotton.

The long staple varieties, Pima S-1 and S-2, have an indeterminate type of growth. These varieties do not have any definite "cut-out" period and will produce new leaves, squares and bolls until frost occurs if moisture is available. Under these conditions many of the bolls will be in a spongy state of growth on October 1. These soft bolls and the lush top growth are attractive to pink bollworm moths seeking a place to oviposit. Because of its indeterminate growth long staple cotton is likely to be more severely damaged than short staple cotton.

The importance of water management in the production of long staple cotton and the suppression of the pink bollworm is illustrated in the procedure used in the past years to find bolls for emergence studies. It was noticed year after year that irrigation water tended to pond on the lower ends of certain fields on certain farms. By November the plants in these areas were considerably taller and bolls were softer while bolls elsewhere in these fields were hard and beginning to open. Where the water had ponded, the cotton plants were succulent and had numerous squares which were attractive for moth oviposition. The plants

in the remainder of these fields was mature and very few pink bollworms were found. Between 1959 and 1963 all severe pink bollworm infestations observed in the county were found at the lower ends of fields where the plants were succulent due to over-irrigation.

A number of experimental varieties of Pima cotton were planted under three types of farming practices in Graham County. These varieties were evaluated for the number of unopened bolls remaining on the stalks after December 1. Twenty-five plants were used in each of 3 replicas for evaluating these varieties. The data in Table 6 indicate that cultural practices are as important as date of planting in affecting boll maturity. In Experiment 1 the grower attempted to produce a late top crop and had a considerable number of large soft bolls remaining on the plants. These were susceptible to pink bollworm infestation whereas, in Experiment 2, the farmer planned his cultural practices so that his cotton matured early. This resulted in only a few mummified unopened bolls, which were not attractive for pink bollworm development. As was expected, in Experiment 3 all varieties of late planted cotton bore many soft bolls at the end of the season. In the first two experiments, planted at a more optimum time, the experimental variety P-15 had the fewest unopened bolls at the end of the season.

Maricopa County: The pink bollworm has only recently become wide-spread in Maricopa County and only limited observations can now be reported. In this county stub cotton has helped to increase pink bollworm populations to their present levels. In stub cotton, squares and flowers appear at least 6 weeks earlier than in planted cotton and thereby furnish the pink bollworm an opportunity to develop one or more extra generations. Numerous infested bolls were observed in a number of stub cotton fields during the first week of July, whereas infested bolls in planted cotton were not observed until the end of September. A loss ranging from 25 to 60% of the crop was evident in stub fields at the end of September, whereas damaging infestations were not observed in planted cotton until November.

Observations made in the fall of 1965 showed that the injury was more severe on long staple cotton than on upland cotton.

On November 13 an examination showed both newly-hatched and older larvae to be present in fields with succulent top growth and numerous soft bolls where growers were attempting to produce a late top crop. At the same time few if any pink bollworm larvae were found in nearby fields where growth had stopped and all bolls were open. This indicates that a late top crop can materially increase the number of overwintering larvae, especially under the favorable winter survival conditions that often prevail in this and adjoining Pinal and Yuma Counties.

Comparative Survival of Pink Bollworms in Bolls and Soil Cocoons

A survey was made in January and February 1965 to determine the percentage of larvae leaving the bolls to overwinter in the soil. This was prompted by recent observations in Arizona, Wene et al. (1965) which showed a high percentage of larvae overwintered in the soil instead of in the bolls. Earlier studies elsewhere by Ohlendorf (1962) and Chapman et al. (1960) reported that most larvae overwintered in the bolls. The Arizona work indicated that the percentage of larvae overwintering in soil cocoons varied from year to year depending on weather conditions. In one experiment, winter survival in soil cocoons was actually more common than in bolls. More than 60% of the larvae had left the bolls to overwinter in the soil.

In this survey, bolls were collected in late January and early February, 1966, from fields in Graham and Maricopa Counties known to be heavily infested with pink bollworms. To insure an adequate supply of bolls about ready to open, the fields to be surveyed were limited to those in which a late top crop was being produced. Each boll was examined for numbers of live larvae and exit holes. An exit hole was considered as a larva which had left the boll to overwinter in the soil. The data in Table 7 shows that an average of 0.18 pink bollworms per boll

were found in the late unopened top crop. These same bolls had an average 1.40 exit holes, indicating that 89% of the larvae had left the bolls to overwinter in the soil.

Considerable rainfall in the winter of 1965 - 1966 delayed plowing. Even though the combination of rain and cold weather killed all of the larvae diapausing in the soil, an alarming spring emergence of adults was indicated. In addition there were sufficient larvae remaining in the unopened bolls above ground to produce a seriously threatening infestation. Boll burial later in the winter could not be expected to effectively suppress this hazard to the 1966 crop.

Effect of Soil Moisture and Temperature on Adult Emergence

Studies of emergence in cages at Safford by Wene et al. (1965) indicated that high winter soil moisture levels reduced spring emergence of adults. A laboratory experiment was conducted at Phoenix to determine whether high soil moisture levels alone, or high soil moisture levels combined with low temperatures, was responsible for the reduction in spring emergence.

Two hundred grams of oven-dried sandy loam soil were placed in each of a series of petri dishes one inch deep and 5.5 inches in diameter. Thirteen larvae collected from cotton bolls were placed on the soil surface in each dish on January 6, 1965. The larvae bored into the soil immediately and spun cocoons. Two days later 30 ml. of water were added to the soil of ten dishes, 70 ml. to ten others, and none to ten other dishes. Half of the test dishes (5 per series) were kept in an office while the remainder were placed in an outdoor insectary. Additional water was added to the moist soil to keep the moisture level constant. Examinations for adult emergence were made daily (Table 8).

The soil with 15% moisture (30 ml. per 200 grams) was of a texture considered ideal for growing cotton. The soil with the higher water content was wet but could not be classified as "muddy" or "soupy." Temperatures during the

experiment are shown in the footnote of Table 8. The data in Table 8 show that adult emergence was hastened by exposing diapausing larvae to warmth. Soil moisture was not necessary for pupation although soil with 15% moisture gave the best emergence of adults both in the office and in the insectary. Exposure to prolonged periods of cold weather decreased adult emergence at both moisture levels with the greater decrease being at the higher level. This agrees with the field data of Chapman et al. (1960) and Wene et al. (1965) and indicates the importance of high soil moisture during the cold weather months as a control for the pink bollworm in Arizona. The moderate soil moisture level optimum for planting cotton also appears to be the ideal level for overwinter survival of pink bollworms. Moderate (15%) soil moisture also promotes early emergence of pink bollworm moths. In Arizona a substantial portion of these early moths will emerge "suicidally" before any squares are present and most of the eggs laid on the plants will hatch before any squares are large enough to support larval development.

A combination of high soil moisture level and low temperature was very effective in reducing the winter survival of larvae in the soil. Date in Table 8 show a 40% survival of larvae in 1964-65 under relatively dry soil conditions in an experiment conducted in the insectary at Phoenix.

The winter of 1965-66 had a considerable amount of rainfall and cold weather. Consequently the 1966 spring adult emergence should be greatly reduced below that of 1965, in Graham County. Because of less rainfall and warmer weather in Maricopa County it is doubtful that the 1965-66 overwintering population will be reduced significantly.

SUMMARY

Burial of bolls early in the winter to a depth of 12 inches gave the best reduction of overwintering pink bollworms. Boll burial to a depth of six inches or less was not as effective. Boll burial to a depth of 2 to 4 inches followed by planting of barley and repeated irrigations to keep the soil wet, destroyed a high percentage of overwintering larvae.

Cage studies showed that as many as 54,000 moths per acre emerged from the soil in a Graham County test between September 15 and October 15, 1965. In spite of the high percentage of larvae in diapause after October 1, results and cage studies showed that considerable numbers of new moths emerged until frost in both Graham and Maricopa Counties. These moths infested late maturing cotton in both counties and first and second instar larvae were common after November 1.

Cultural practices aided greatly in reducing pink bollworm infestations. In Graham County the Acala 1517D variety, when grown properly, "cut-out" (ceased fruiting) about September 1 and was very lightly infested. Pima S-2 continued growth until frost and became heavily infested. Early planting and application of water so as to prevent the development of late squares and late succulent growth made the plants of Pima S-2 variety unattractive for pink bollworm oviposition. This production practice prevented the late development of bolls which if produced would be unable to mature but would be capable of producing substantial overwintering populations of pink bollworms. A new variety of long staple cotton, P-15, matured early and did not become heavily infested.

In Maricopa County early squaring of stub cotton was favorable for early season build-up of pink bollworm populations. Damaging infestations were found in stub fields by the middle of July whereas in planted cotton such infestations did not occur until the end of October. It is therefore important that stub cotton be eliminated. Planted cotton should be managed to mature about the

middle of October or earlier, if possible. Production of a late top crop was favorable for development of pink bollworm larvae which remained active until frost.

Most larvae overwintered in the soil. A combination of high soil moisture levels and cold weather killed a high percentage of these larvae. However, cold weather and high moisture levels had little effect on larval survival within immature bolls. It is therefore important that the crop be so managed that these late bolls do not develop.

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Table 1. Effect of burial of bolls in the fall of 1964 on emergence of pink bollworm adults from cages at Safford and Phoenix in the spring of 1965.

Inches, bolls buried	Average No. Moths Emerging per Cage	
	Safford	Phoenix
0	6.0	47.2
2	3.0	6.8
2 with barley	0.5	6.2
4	3.0	14.0
4 with barley	0.3	6.4
6	6.3	2.1
12	1.1	1.8

Table 2. Development of diapause in pink bollworm larvae at Solomon and Rainbow Valley, 1965.

Date of Larval Collection		No. Larvae	Percent Larvae in Diapause at Solomon	Rainbow Valley
September	9	36	0	
	14	52	3.8	
	20	28		0
	21	23	39.1	
	24	58		79.3
	28	55		78.2
	29	59	79.7	
October	5	31	96.8	
	5	91		83.5
	13	50		86.0
	15	57	66.7[1/]	
	26	67	93.4	
	26	81		90.1
November	2	39	92.4	
	10	146		92.4

1/ Bolls were half grown and soft.

Table 3. Emergence of pink bollworm adults in the fall from the soil in field cages at Solomon, Graham County, 1965.

Emergence Period	Number of Pink Bollworm Moths Emerging Per Acre[1/]	
	Untreated	Treated [2/]
September 15-21	15,125	8,591
22-30	30,129	14,036
October 1-7	10,164	8,591
8-14	13,157	6,665
15-21	1,210	874
22-30	484	968
Total	70,269	39,715

1/ Based on numbers observed in 6 field cages in each treatment.

2/ Treated with 4 lbs. of Toxaphene plus 2 lbs. of DDT per acre on September 15, 20, and 25, and with 4 lbs. of Strobane plus 2 lbs. DDT per acre on September 30, October 7, and 14, 1966.

Table 4. Emergence of pink bollworm adults from infested bolls placed in cages at various dates in Graham and Maricopa Counties, 1965.

	ADULT EMERGENCE PER CAGE IN TESTS IN							
	Graham County				Maricopa County			
	Test #1[1/]	Test #2[2/]	Test #3[3/]	Test #4[4/]	Test #5[5/]	Test #6[6/]	Test #7[7/]	Test #8[8/]
Oct 5-9	30.5							
10-16	27.3				6.0	0.5	3.0	
17-23	5.3		0.5		20.5	2.5	13.0	
24-30	3.8	0.5	0.5		25.3	5.0	14.0	
Oct 31-Nov 6	2.5	1.5	0.5	0.5	16.7	3.5	4.5	0.5
Nov 7-13	0.5	1.0	0		13.0	3.0	4.0	0.3
14-20	0	0	0		1.3	0.5	1.0	1.3
21-27	0.3	0.5	0.5		0.5		1.0	1.5
Total per Cage	70.2	3.5	2.0	0.5	77.3	15.0	40.5	3.6

1/ Bolls from severely infested fields installed 9/15

2/ Majority of larvae in first and second instars when bolls installed on 9/29

3/ Bolls from same field as in Test 1 installed on 9/29

4/ Bolls from same field as in Test 1 installed on 10/9

5/ Bolls from field with 60% of the crop destroyed installed on 9/28

6/ Bolls from upland cotton infested with first and second instar larvae installed in 9/28

7/ Bolls from field with 25% of the crop destroyed installed on 9/28

8/ Bolls from same field as in Test 7 installed on 10/12

Table 5. Control of a heavy pink bollworm infestation in the top crop of a field with six insecticide applications. Graham County, 1965.

Sample No.[2]	Infestation per 100 Bolls					
	Untreated			Treated[1]		
	Exit Holes	Larvae	Total	Exit Holes	Larvae	Total
1	122	83	205	34	4	39
2	150	102	252	35	8	43
3	107	83	190	39	7	46
4	86	89	175	31	6	37
5	113	84	197	19	5	24
Average Per Boll	1.16	0.88	2.04	0.31	0.06	0.37

[1] Treated with 4 pounds of Toxaphene plus 2 pounds of DDT on 9/15, 9/20, 9/25 and with 4 pounds of Strobane plus 2 pounds of DDT, 9/30, 10/7, and 10/14.

[2] Boll samples were collected at 5 points in each treatment on October 27.

Table 6. Number of unopened bolls remaining on various experimental varieties of Pima cotton in December. Graham County. 1965.

	Av. No. Bolls Remaining on Plants	Condition of Bolls	Av. No. Pink Bollworms Per 100 Bolls
	Experiment 1:[1] Planted April 15[2]		
Pima S-2	4.6	Soft	24.0
P-15	3.3	Soft	21.4
P-17	8.7	Soft	33.6
P-18	5.0	Soft	22.0
E-1044	5.3	Soft	36.8
	Experiment 2:[1] Planted April 15[3]		
Pima S-2	0.8	Small, hard	0 [4]
P-15	0.7	Small, hard	0
P-17	0.7	Small, hard	0
P-18	1.0	Small, hard	0
E-1044	1.1	Small, hard	0
	Experiment 3:[1] Planted May 20		
Pima S-2	3.2	Soft	0 [5]
P-15	3.7	Soft	0
P-17	5.5	Soft	0
P-18	3.3	Soft	0
E-1044	4.2	Soft	0

[1] Data taken from the U.S.D.A. plant breeding experiments conducted by Dr. Carl Feaster. Twenty-five plants in each of three replicas were used as the basis of evaluating these varieties.

[2] Grown so as to produce a late top crop.

[3] Grown so as to harvest the entire crop early.

[4] Light infestation observed on earlier bolls in September.

[5] No infestation ever observed in these plots.

Table 7. Pink bollworm infestation levels in late developing unopened bolls, 1965-66.

Date	Area	Cotton Staple	Bolls		Infestation per Boll in Late Top Crop	
			Number	Percent Infested	Larvae	Exit Holes
1-30	Pima [1/]	Long	70	70	0.01	0.83
2-4	Mesa	Short	50	92	0.24	0.83
2-4	Mesa	Long	50	92	0.24	1.50
2-4	Mesa	Short	50	60	0.04	1.40
2-4	Scottsdale	Long	50	78	0.16	1.42
2-10	Tonopah	Long	50	92	0.16	1.26
2-10	Tonopah	Long	50	80	0.22	1.08
2-10	Rainbow Valley	Long	50	86	0.16	1.22
2-10	Rainbow Valley	Short	50	82	0.24	1.60
2-10	Rainbow Valley	Short	50	94	0.34	2.78
Average				82.6	0.18	1.40

[1/] Graham County. All other areas were in Maricopa County.

Table 8. Effect of moisture and temperature on emergence of adults from diapausing larvae in the soil. Phoenix. 1965.

Date	Percent Adult Emergence from Bolls at Moisture Levels of					
	0% in		15% in		33% in	
	Insectary[1/]	Office[2/]	Insectary	Office	Insectary	Office
February 21-28	0	9	0	20	0	14
March 31	2	26	15	51	3	65
April 30	1	43	29	82	6	68
May 31	29	72	55	92	37	69
June 30	38	76	58	92	37	69
July 21	40	76	58	92	37	69

1/ Average maximum and minimum temperatures in 1965 were:

67	and	43	in January
65	and	39	in February
69	and	43	in March
77	and	50	in April
89	and	54	in May
97	and	61	in June
105	and	76	in July

2/ An attempt was made to keep the office temperature at 76°F.