Table 4

Comparison of Yields from Various Treatments
for Control of the Pink Bollworm. Phoenix, 1968.

| Treatment | Rate Lb./A. | Number Applications | Yields Lbs. Seed Cotton/A. | Stat. Sig. |
|---|---|---|---|---|
| Check | ----- | 0 | 3018 | n.s. |
| Scheduled Applications | | | | |
| Azinphosmethyl | 0.75 | 9 | 3333 | |
| Azodrin® | 0.94 | 9 | 3132 | |
| Applications based on weekly Counts | | | | |
| Azinphosmethyl | 0.75 | 6 | 3276 | |
| Azodrin® | 0.94 | 6 | 3172 | |

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## ECOLOGICAL FACTORS AFFECTING THE ABUNDANCE AND CULTURAL CONTROL OF THE PINK BOLLWORM

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### Objectives

A. To study environmental factors influencing behavior and abundance of the pink bollworm.

B. To investigate physical, mechanical, cultural, chemical, and biological agents as possible control measures under Arizona conditions.

Summary of Progress - Cultural Control

A. Post-harvest Tillage: The cultural control experiments conducted during the winter of 1967-68 at the Mesa, Yuma and Safford Experiment Farms were terminated at approximately mid-August. Prior to the termination of these experiments all plots were irrigated to provide the moisture necessary for pupation of the remaining larvae. A sufficient period of time was allowed for moth emergence to occur before terminating the tests.

Tables 1, 2 and 3 present the results of the various cultural practices at Mesa, Yuma and Safford, respectively. Results of these experiments indicate that moth emergence was greatest at Yuma, intermediate at Mesa and lowest at Safford. Because of the extremely low emergence at Safford, no logical explanation can be given concerning the results. There was no significant difference between cultural treatments in that experiment (Table 3).

Differences were observed between certain treatments in the Mesa and Yuma tests. The trend with regard to the various treatments was very similar at both locations. In general, where the plant residue was removed, the least amount of moth emergence occurred. Where plant debris was left on the soil in combination with minimum tillage, i.e., soil undisturbed or disked, the greatest moth emergence occurred. Moth emergence from plots which were rototilled or plowed was intermediate.

Not only did more moths emerge from plots in the Yuma experiment as compared to the Mesa test but more emerged after cotton in the area had begun to square. Suicidal emergence at Yuma ranged from 38.4% to 66.5% for the various cultural treatments in contrast to a range of 72.9% to 88.2% at Mesa. This, even though overall numbers might be low, could have a significant impact on rate of population buildup during the growing season.

B. Plowdown Date: A comparison of total spring moth emergence from the various plowdown dates is given in Table 4. At Mesa, significant differences were found in comparing the various dates with regard to suicidal moth emergence. However, non-suicidal and total moth emergence indicated no significant differences, even though there was less emergence in the earlier plowdown dates. The greatest moth emergence occurred in the last plowdown date, January 5.

At both Yuma and Safford, although only two dates were compared, the greater moth emergence occurred in the first plowdown date. However, with the exception of non-suicidal (effective) emergence at Yuma, these differences were not significant.

C. Stalk Destruction: A comparison of several stalk shredders with hand-harvested checks is given in Table 5. At Mesa, two vertical flail and one rotary shredder were compared. The Brady vertical flail was compared with the hand-harvested checks at Safford. None of the shredders reduced moth emergence when compared with the hand-harvested check.

At both Mesa and Safford the percent suicidal moth emergence was much reduced in the shredding tests when compared to that occurring in

the cultural experiments. The micro-habitats in which the larvae were over-wintering were obviously quite different. This presents an interesting example of the potential for manipulating the time of spring moth emergence.

D. Plant Residue Removal: Certain treatments in the cultural control tests were included to help clarify the relative importance of those larvae which leave the bolls to over-winter on or in the soil. Results of these treatments are shown in Table 6. In the tests where larger numbers of moths emerged--Mesa and Yuma--the removal of above-ground plant debris resulted in reducing moth emergence by approximately 50 percent. Additionally, where the soil was not tilled following the removal or shredding of plant debris, more moths emerged after squaring began than where the soil was disked. More moths emerged where residue was removed at Safford; however, this is probably a random occurrence due to the extremely low emergence in this area.

E. Pre-Plant Practices: (1) Pre-Plant Irrigation: The influence of irrigation water on spring moth emergence was investigated at Mesa and Yuma. A late winter irrigation was performed at each location to simulate a pre-plant operation. At each location the early irrigation was compared on each of two tillage practices--rototilled or plowed at Mesa and disked or plowed at Yuma.

The tillage treatment preceding the early irrigation at Mesa apparently had little if any influence on the effects of the irrigation. However, moth emergence from the irrigated plots was significantly reduced when compared to non-irrigated plots (Table 7). At Yuma, the tillage practices did significantly affect moth emergence in relation to irrigation. Significantly more moths emerged from the disked and irrigated treatment than from the plowed and irrigated plots. Table 8 presents the results where both tillage treatments were combined. Moth emergence was slightly greater, although not significant, where the plots were irrigated on February 28, 1968.

(2) Early- and Late-Spring Irrigations: Results of the early-spring irrigation at Mesa (March 19, 1968) following a furrowing-out operation resulted in significantly less moth emergence than in the comparable non-irrigated plots. However, this cannot be attributed to the irrigation since approximately the same number of moths emerged from furrowed-out plots without a subsequent irrigation (Table 7).

A late-spring irrigation test at Yuma was conducted to determine the effects of applying water by two methods--border or sub-irrigation--on moth emergence. There was no significant difference in total moth emergence between the two methods or between the irrigated and non-irrigated treatments (Table 8). However, the irrigated treatments delayed emergence long enough after the water was applied to result in significantly more suicidal moth emergence in the non-irrigated plots.

Table 1

Influence of Various Cultural Practices on Spring Emergence of the Pink Bollworm. Mesa, Arizona. 1967-68.

| Treatment | Treatment Means and Significance (5%)[1] Suicidal | Non-Suicidal | Total | Percent Suicidal Emergence |
|---|---|---|---|---|
| Removed Residue, disk | 5.08 a | 0.68 a | 5.76 a | 88.2 |
| Rotary Shred, disk; rototill; Re-rototilled after two weeks | 5.56 a b | 0.96 a | 6.52 a | 85.3 |
| Removed Residue only | 5.64 a b | 1.64 a | 7.28 a b | 77.5 |
| Rotary Shred; disk; rototill | 6.72 a b c | 1.80 a | 8.52 a b | 78.9 |
| Rotary Shred; disk; plow | 7.64 a b c | 1.24 a | 8.88 a b | 86.0 |
| Rotary Shred; disk | 10.20 b c | 2.16 a | 12.36 b c | 82.5 |
| Rotary Shred only | 10.88 c | 4.04 b | 14.92 c | 72.9 |

[1] Duncan's Multiple Range Test; Both non-suicidal and total moth emergence were significant at the 1% level.

Table 2

Influence of Various Cultural Practices on Spring Emergence of the Pink Bollworm. Yuma, Arizona. 1967-68.

| Treatment | Treatment Means and Significance[1] Suicidal (N.S.) | Non-Suicidal (5%) | Total (5%) | Percent Suicidal Emergence |
|---|---|---|---|---|
| Removed Residue; disk | 7.7 | 7.6 a | 15.3 a | 50.3 |
| Shred; disk; rototill | 13.5 | 6.8 a | 20.3 a b | 66.5 |
| Removed Residue only | 8.7 | 13.5 a b | 22.2 a b c | 39.2 |
| Shred; disk; plow | 13.9 | 11.3 a | 25.2 a b c | 55.2 |
| Shred; disk | 16.9 | 19.1 a b | 36.0 b c | 46.9 |
| Shred only | 15.0 | 24.1 b | 39.1 c | 38.4 |

[1] Duncan's Range Test.

Table 3

Influence of Various Cultural Practices on Spring Emergence of the Pink Bollworm. Safford, Arizona. 1967-68

| Treatment | Treatment Means and Significance[1] Suicidal | Non-Suicidal | Total | Percent Suicidal Emergence |
|---|---|---|---|---|
| Shred; disk; plowed Barley Planted | 0.8 | 0.3 | 1.1 | 72.7 |
| Shred; disk; rototilled | 0.8 | 0.4 | 1.2 | 66.7 |
| Shred; disked | 0.8 | 0.6 | 1.4 | 57.1 |
| Shred only | 1.1 | 0.6 | 1.7 | 64.7 |
| Residue Removed Only | 1.3 | 1.0 | 2.3 | 56.5 |
| Residue Removed; disk | 1.3 | 1.0 | 2.3 | 56.5 |
| Shred; disk; plowed 12" | 1.2 | 1.2 | 2.4 | 50.0 |
| Residue Removed; disk; plowed 12" | 1.6 | 0.9 | 2.5 | 64.0 |

[1] No significant differences among treatments.

Table 4

Influence of Plow-Down Date on Spring Moth Emergence. 1967-68.

| Plow-Down Date | Treatment Means and Significance[1] Suicidal | | Non-Suicidal | | Total | | Percent Suicidal Emergence |
|---|---|---|---|---|---|---|---|
| | Mesa Experiment Farm | | | | | | |
| | 5% | | n.s. | | n.s.[2] | | |
| October 1-6, 1967 | 3.46 | a | 0.46 | | 3.94 | | 87.8 |
| October 17, 1967 | 6.40 | a | 0.97 | | 7.37 | | 86.8 |
| November 1, 1967 | 4.97 | a | 1.69 | | 6.66 | | 74.6 |
| December 5, 1967 | 7.91 | ab | 2.91 | | 10.83 | | 73.0 |
| January 5, 1968 | 14.20 | b | 2.91 | | 17.11 | | 83.0 |
| | Yuma Experiment Farm | | | | | | |
| | n.s. | | | 5% | | n.s. | |
| November 21, 1967 | 12.03 | | 17.43 | a | 29.47 | | 40.8 |
| December 28, 1967 | 13.20 | | 10.03 | b | 23.23 | | 56.8 |
| | Safford Experiment Farm | | | | | | |
| | n.s. | | | n.s. | | n.s. | |
| November 13, 1967 | 1.23 | | 0.98 | | 2.20 | | 55.9 |
| December 15, 1967 | 1.00 | | 0.53 | | 1.53 | | 65.4 |

[1] Duncan's Multiple Range Test.

[2] Total emergence was significant at the 10 percent level.

Table 5

Comparison of Several Stalk Shredders Against the Pink Bollworm. 1967-68

| Treatment[2] | No. Moths Emerging/Treatment[1] Suicidal | Non-Suicidal | Total | Percent Suicidal |
|---|---|---|---|---|
| | Mesa Experiment Farm | | | |
| Hand-harvested check | 224 | 536 | 760 | 29.5 |
| Servis Rotary | 218 | 551 | 769 | 28.3 |
| Sun Vertical Flail | 172 | 594 | 766 | 22.5 |
| M-C Vertical Flail | 191 | 583 | 774 | 24.7 |
| | Safford Experiment Farm | | | |
| Hand-harvested check | 15 | 40 | 55 | 27.3 |
| Brady Vertical Flail | 10 | 60 | 70 | 14.3 |

[1] No significant difference in moth emergence occurred in either test.
[2] Each treatment consisted of three replications, each containing the plant material from two rows, fifty feet in length.

Table 6

Effects of Removing Plant Residue on Spring Moth Emergence. 1967-68

| Treatment | Mean No. Moths Emerging/Plot Suicidal | Non-Suicidal | Total | % Reduction with Residue Removed |
|---|---|---|---|---|
| | Mesa Experiment Farm | | | |
| Residue Removed | | | | |
| Disked | 5.08 | 0.68 | 5.76 | -53.4 |
| Soil undisturbed | 5.64 | 1.64 | 7.28 | -51.2 |
| Residue Left | | | | |
| Disked | 10.20 | 2.16 | 12.36 | |
| Soil undisturbed | 10.88 | 4.04 | 14.92 | |
| | Yuma Experiment Farm | | | |
| Residue Removed | | | | |
| Disked | 7.7 | 7.6 | 15.3 | -57.5 |
| Soil undisturbed | 8.7 | 13.5 | 22.2 | -43.1 |
| Residue Left | | | | |
| Disked | 16.9 | 19.1 | 36.0 | |
| Soil undisturbed | 15.0 | 24.1 | 39.0 | |
| | Safford Experiment Farm | | | |
| Residue Removed | | | | |
| Disked | 1.3 | 1.0 | 2.3 | +64.3 |
| Soil undisturbed | 1.3 | 1.0 | 2.3 | +35.3 |
| Residue Left | | | | |
| Disked | 0.8 | 0.6 | 1.4 | |
| Soil undisturbed | 1.1 | 0.6 | 1.7 | |

Table 7

Influence of Spring Irrigation on Pink Bollworm Moth Emergence. Mesa, Arizona. 1967-68

| Treatment | Treatment Means and Significance[1] Suicidal | Non-Suicidal | Total | Percent Suicidal Emergence |
|---|---|---|---|---|
| | Mesa - Border Irrigated Jan. 19 | | | |
| Winter Tilled[2] | 10% | 5% | 10% | |
| Non-Irrigated | 17.2 a | 3.3 a | 20.5 a | 83.9 |
| Winter Irrigated | 4.5 b | 1.0 b | 5.5 b | 81.8 |
| | Mesa - Furrow Irrigated Mar. 19 | | | |
| Winter Tilled[2] | 5% | 5% | 5% | |
| Non-Irrigated | 16.4 a | 3.3 a | 19.7 a | 83.2 |
| Furrowed out; non-irrigated | 3.1 b | 1.1 b | 4.2 b | 73.8 |
| Furrowed out; spring irrigated | 1.4 b | 0.2 b | 1.6 b | 87.5 |

[1] Duncan's Multiple Range Test.

[2] No differences were obtained between the two tillage practices which were compared; therefore, treatment means are composites of the rototilled and plowed treatments.

Table 8

Influence of Spring Irrigation on Pink Bollworm Moth Emergence. Yuma, Arizona. 1967-68

| Treatment | Treatment Means and Significance Suicidal | Non-Suicidal | Total | Percent Suicidal Emergence |
|---|---|---|---|---|
| | Irrigated Feb. 28 | | | |
| Tilled | n.s. | n.s. | n.s. | |
| Non-Irrigated | 12.50 | 6.38 | 18.88 | 66.2 |
| Spring Irrigated | 11.75 | 8.13 | 19.88 | 59.1 |
| | Irrigated Apr. 5 | | | |
| Tilled | 5% | n.s. | n.s. | |
| Non-Irrigated | 9.00 a | 8.50 | 17.50 | |
| Border Irrigated | 0.25 b | 12.50 | 12.75 | |
| Sub-Irrigated | 0.50 b | 16.00 | 16.50 | |