LIFE TABLE ANALYSIS OF COTTON BOLL WEEVIL IN THE TROPICS OF TAMAULIPAS MEXICO AFTER Catolaccus grandis RELEASES

J. Vargas-Camplis
INIFAP -CERIB
Tamaulipas, Mexico
R.J. Coleman
USDA-ARS-SARL
Weslaco, TX
J. Gonzalez
INIFAP-CELAD
Abasolo, Tam
L. Rodriguez Del B.
INIFAP-CIRNE
Rio Bravo, Tam.

Abstract

The Boll Weevil, *Anthonomus grandis* Boheman, is the most important insect pest to cotton production in Mexico, particularly in the Northeast. The present experiment was conducted in the Southern Region of Tamaulipas, Mexico, near the Tropic of Cancer, in the Summer of 1996. Two cotton fields of four hectares each were used. In one of the fields only females of *Catolaccus grandis* (Burks) were released to control early infestation of boll weevil, *A. grandis* Boheman. In the other field boll weevil infestations were controlled according to commercial insect management; that is, insecticide spray when economic threshold was reached. A total of 14 releases were made twice a week except the last one which was made seven days apart. An average of 950 adult females per hectare were released (380 adults per acre). For cohort life table analysis, infested squares (eggs or first instar larva) from commercial cotton check field were collected and grouped ten per cord. The number of groups varied according to the availability of infested squares (6 to 12 every date). These were left on the field for two weeks, then they were picked up and taken to the laboratory for analysis. For interpretation purposes, the results of cohorts were grouped in three seasons (early, mid and late seasons). Results obtained showed that *Catolaccus grandis* is the main mortality factor for third instar boll weevil larvae in both aspects known; that is, as parasitoid and adult feeding habits in second and third instar larvae. The highest mortality was obtained during the early season followed by the mid season. The results obtained in the check field showed that parasitoids did not represent an important mortality factor for boll weevil. A total of 10 sprays were applied in the commercial field, 7 for boll weevil control and 3 for other insects such as aphids and bollworm. In the release field, only 3 sprays for boll weevil were needed. Yield of seed cotton was similar in both fields.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1194-1197 (1997)
National Cotton Council, Memphis TN

Introduction

The cotton boll weevil is a native pest of Meso America (Burke et al 1986) which includes Southern Mexico. The movement of boll weevil toward the north has been without the natural enemies that keep this insect under control in its natural region. Therefore, this insect has become the most important pest in the cotton region of Mexico and of most of the cotton belt of the United States of America. In Northern Mexico which includes nearly 2.5 million acres of agricultural land planted to grain sorghum and corn, cotton is the third most important cash crop (Tables 1 and 2) and boll weevil takes in some cases up to 40% of the investment and very often 25 to 30% of the investment. This important agricultural region is separated from the Lower Rio Grande Valley only by the Rio Grande River, and cotton is grown in 250,000 acres as a yearly average. Boll weevil is also the key pest for the cotton production.

Boll weevil in this area has been mismanaged, causing confusion and controversy due to lack of adequate ecological information on this insect's habits which have been poorly studied; therefore, ecological life tables are one of the most useful tools in the study of insect population dynamics (Hartcourt 1969). Life table studies help us to describe survival and mortality in a population. This activity shows what stage of the studied insect has the higher mortality, J. A. Morales et al (1995) found out that, in a life table study, the first cause of mortality of boll weevil third instar larvae was *Catolaccus grandis* (Burks).

Materials and Methods

The following experiment was conducted at Llera Tamaulipas Mexico, which is located at longitude 98° 57'00" and latitude 23°19'30". The altitude is 278 msnm, the area is located 10 miles south of the Tropic of Cancer. Climate is hot and subhumid annual rainfall is 950 mms and mean temperature 23 °C. The study was carried out on cotton that was planted to evaluate the impact of *Catolaccus grandis* releases versus no releases and conventional management (IPM control for Boll weevil). Each plot had 4-00-00 Hectares and they were 700 mts apart from each other.

Planting date was July 6 to 12, variety used was Deltapine 50 population density was 75,000 pts/ha, only one irrigation was necessary due to rainfall (Table No 3). Releases of *Catolaccus* (Table 4) were made on a biweekly basis (Tuesday and Friday), female adults released were reared at the Weslaco Tx. Subtropical Agricultural Research Laboratory of USDA-ARS. Insect control in the check plot was treated according to the extension service. The *Catolaccus* releases started when 30% to 40% of plant population had "match head" square size. In both fields, collection of 20 samples of 1 mt were taken, collecting and recording squares in the plants as well as on the ground, and boll weevil infested squares were taken to the laboratory for dissection and to determine if they were parasitized.

For the life table study, the cohort system reported by Morales-Ramos J.A. et al 1994, was used. A total of 13 different dates were established starting August 27 and ending October 23. Each date consisted of six or twelve groups in each field, each group had 10 squares infested by boll weevil (eggs or first instar larvae). These were tied to a cord. Each cord was also tied 10 to 15 cms (4" to 6") above the ground level on the line of plants, and they were left on the field for two consecutive weeks, then collected and taken to the laboratory for dissection.

Insect problems in the commercial cotton field were sprayed according to need based on the economic threshold for pest problem (Table 5).

Results and Discussion

For Catolaccus releases, the south was preferred because we could ensure boll weevil population from the very beginning. We had higher infestation in the southwest than in the southeast. The commercial field check was located 700 mts to the north; we started with lower infestation in the northwest and it took two to three weeks to find infestation in the northeastern side (120 mt from the west). We observed a very slow dispersion movement of the boll weevil population in the check field.

Results from the release field gave us information about how inundating releases of *Catolaccus* can help in the management of boll weevil problems in this region, especially without insects such as Fleahopper and Boll worm during the early season. Fig. 1 shows how the mortality was in 3rd instar boll weevil larvae which is the preferred stage of this parasitoid. After October 11 This mortality decreased and chemical insecticides had to be used. But we also made the last release in September 17 on a biweekly basis as established.

For interpretation of the life table study, and based on the release schedule, we divided the results in three season: Early season from August 27 to September 13 (Table 6), Midseason from September 17 to Sep. 29 (Table 7) and Late season from October 2 to Oct. 23 (Table 8). During the first season in the *Catolaccus* field it was found that 10% survival of boll weevil and 86% of the mortality was found in 3rd instar larvae (both feeding and host parasite), during this time we also found 17% mortality in the commercial plot due to *Catolaccus* (Host and feeding habits). In the mid season boll weevil survival in the releasing field was 16% from the total, while in the check it was 88% and 7% of 12% mortality we assumed it was due to feeding habits, as in the early season. In the late season starting on October 2, the boll weevil survival increased (we ended the periodic releases in Sep. 17) in the release field up to 55% versus 88% in the check field

The sprays for boll weevil in the commercial field were eigth and caused some outbreaks such as aphids and bollworm that we had to spray once (Table 5) versus three sprays at the end of the season in the *Catolaccus* field.

To obtain the seedcotton yield we harvested 10 samples of 16 m^2 (2 rows of 10 meter long) in each field. Although seed cotton yield is not a parameter associated directly with the objective of this study, it is important to mention that no significant differences were observed when *Catolaccus* field and check field were compared. Also it is important to mention an observation related to insecticide sprays for boll weevil which may cause an outbreak of aphids presented in the check commercial field (Table 5) that also had to be controlled by chemical insecticide.

Summary and Conclusions

Parasitism observed in the check field was consistently lower than in the *Catolaccus* releasing field, however unknown mortality in the commercial check was higher in the early parasitoid releases probably due to lack of host in releasing field.

Parasitism due to *C. grandis* was shown to be responsible for the highest mortality of boll weevil population.

Rainfall registered during the season reduced the effectiveness of the insecticides sprays for boll weevil, and this situation appears normal in this area, therefore, biological control of *A. grandis* represent an important tool for insect control in the commercial cotton fields.

An outbreak of aphids at the beginnning was caused after the first boll weevill which had to be controlled by insecticide. Seed cotton yield were similar in both field.

Acknowledgement

We thank M.G. Rojas and J. A. Morales-Ramos from Subtropical Agricultural Research Laboratory of the Biocontrol Unit for providing the biological material to conduct this test.

References

Burke, H.R., W. E. Clark, J.R. Cate, and P. A. Fryxell. 1986. Origin and Dispersal of the Boll weevil. Bull. Entomol. Soc. Amer. 32:228-238.

Morales-Ramos J..A., M. G. Rojas, J. Robertson, R. G. Jones, E. G. King , K.R. Summy, and J. R. Brazzel. 1994. Suppression of the Boll weevil first generation by augmentative releases of Catolaccus grandis. Proc Beltwide Cotton ConferencesVol 2 pp 958-964 National Cotton Council Of America San Diego, Ca.

Harcourt, D. G. 1969. The Development and use of Life Tables in the study of Natural Insect Populations. Annual Review of Entomology 14:175-196.

Morales - Ramos J.A., K. R. Summy, and E. G. King. 1995. Estimating Parasitism by Catolaccus grandis (Hymenoptera: Pteromalidae) After Inundative Releases Against the Boll Weevil (Coleptera: Curculionidae) Environmental Entomology 24(6):1718-1925.

Table 1. Cotton Acreage and yield in Northern Tamaulipas Mexico 1990-1996

Year	Hectares planted	Hectares Harvested	Tot. Yield Ton.	Yield Ton/ha
1990	11,339	10,661	19,117	1.793
1991	73,974	60,425	109,658	1.815
1992	5,870	5,770	7,044	1.221
1993	3,523	2,951	4,578	1.551
1994	25,351	24,288	26,876	1.109
1995	48,282	37,689	39,598	1.051
1996	22,051	20,302	20,505	1.010
Mean	27,198	23,155	32,482	1.364

Table 2. Cotton Acreage and yield of seed cotton in Southern Tamaulipas Mexico 1990-1996

Year	Hectares planted	Hectares Harvested	Total Ton.	Yield Ton/ha
1990	20,980	20,378	32,273	1.830
1991	31,400	30,455	46,318	1.520
1992	8,471	7,763	14,889	1.930
1993	19,973	17,414	24,771	1.420
1994	55,462	54,218	72,448	1.340
1995	51,916	47,402	50,786	1.070
Mean	31,367	29,605	40,247	1.517

Table 3.- Rainfall registered during the evaluation test at Llera, Tam 1996

Date	**mms**
August 23	17.0
August 24	111.0
August 25	23.0
August 26	16.0
Sept., 01	34.0
Sept. 02	7.0
Sept. 03	73.0
Sept. 07	18.0.
Sept. 15	29.5
Sept. 18	20.6
Sept., 21	6.0
Sept. 28	12
Sept. 29	36

Table No 4.- *Catolaccus* females releases dates in Llera Tam. Mexico 1996

Release date	**# females**
August 6	3960
August 9	4,000
August 13	4,600
August 16	4,600
August 20	3,820
August 23	3,820
August 27	3,900
August 29	3,820
Sept. 03	3,800
Sept. 06	3,800
Sept. 10	4,100
Sept. 13	3,000
Sept. 17	3,000
Sept. 24	3,000
Total	**53220**

Table 5.- Number of sprays in the plot with conventional management and the *Catolaccus* Plot.

Date	**Insect**	**Field sprayed**
Aug. 27	Boll weevil	Check
Sept. 10	Boll weevil	Check
Sept. 12	Aphids	Check
Sept. 19	Boll worm	Check
Sept. 26	Boll weevil	Check
Oct. 1	Bworm and Boll Weevil	Check
Oct 11	Boll weevil	Check
Oct. 18	Boll weevil	Check
Oct. 23	Boll weevil	Catolaccus
Nov. 5	Boll weevil	Catolaccus & Check
Nov. 10	Boll weevil	Catolaccus & Check

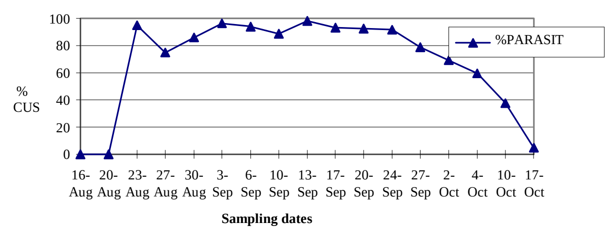

Fig. 1 Parasitism of Catolaccus sp. in 3rd instar boll weevil larvae. Llera, Tam. Mexico 1996

Table 6.- Life table analysis from boll weevil cohorts in the Llera-Mante area, Tamaulipas Mexico. Cohorts from August 27 to September 13, 1996

Stage	lx	qx %	ind %
n= 256	**Catolaccus release field**		
Egg	256	12.11	1.40
Instar 1	225	0.00	0.00
Instar 2	225	16.00	1.93
U.M.[a]		16.00	1.93
Instar 3	189	86.24	63.67
U.M.[a]		34.92	26.17
M.P.[b]		50.00	37.13
Pupa	26	0.00	0.00
Adult	26	0.00	
n= 261	**Commercial field**		
Egg	261	17.62	13.44
Instar 1	215	0.00	0.0
Instar 2	215	2.79	1.80
U.M.[a]		2.79	1.80
Instar 3	209	19.14	14.87
U.M.[a]		10.05	7.81
M.P.[b]		9.09	7.06
Pupa	169	2.96	1.92
Adult	64	0.00	

lx = survival from eggs to stage x
qx= mortality occurring during stage x
ind= indispensable mortality occurred during stage x
a= unexplained mortality
b= mortality due to *Catolaccus grandis*

Table 7.- Life table analysis from boll weevil cohorts in the Llera-Mante area, Tamaulipas Mexico. Cohorts from September 17 to September 29, 1996

Stage	lx	qx	ind
n= 319	**Catolaccus release field**		
Egg	319	10.97	2.01
Instar 1	284	0.00	0.0
Instar 2	284	19.01	3.83
U.M.a		19.01	3.83
Instar 3	230	72.17	42.28
U.M.[a]		33.48	19.61
M.P.[b]		38.70	22.67
Pupa	64	18.75	3.76
Adult	52	0.00	
n= 356	Commercial field		
Egg	356	3.93	3.60
Instar 1	342	0.00	0.00
Instar 2	342	1.17	1.04
U.M.a		1.17	1.04
Instar 3	338	6.80	6.42
U.M.[a]		6.51	6.14
M.P.[b]		0.30	0.28
Pupa	315	0.63	0.56
Adult	313	0.00	

lx = survival from eggs to stage x
qx= mortality occurring during stage x
ind= indispensable mortality occurred during stage x
a= unexplained mortality
b= mortality due to *Catolaccus grandis*

Table 8.- Life table analysis from boll weevil cohorts in the Llera-Mante area, Tamaulipas Mexico. Cohorts from October 2 to October 23, 1996

Stage	lx	qx	ind
n= 280	Catolaccus release field		
Egg	280	0.71	0.40
Instar 1	278	0.00	0.00
Instar 2	278	2.52	1.42
U.M.a		2.52	1.42
Instar 3	271	40.59	37.58
U.M.[a]		21.77	20.16
M.P.[b]		18.82	17.42
Pupa	161	4.35	2.50
Adult	154	0.00	
n= 356	Commercial field		
Egg	248	1.06	0.94
Instar 1	281	0.36	0.31
Instar 2	280	0.71	0.63
U.M.a		0.71	0.63
Instar 3	278	7.55	7.19
U.M.[a]		7.55	7.19
M.P.[b]		0.00	0.00
Pupa	257	2.72	2.46
Adult	250	0.00	

lx = survival from eggs to stage x
qx= mortality occurring during stage x
ind= indispensable mortality occurred during stage x
a= unexplained mortality
b= mortality due to *Catolaccus grandis*