

APPROXIMATE NUMBER OF ANNUAL FIELD
GENERATIONS OF PINK BOLLWORM, *PECTINOPHORA*
GOSSYPIELLA (SAUNDERS)

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Abstract

Field trials were carried out to estimate the number and duration of cotton bollworm, *Pectinophora gossypiella* (Saunders) field generations during three seasons (1993, 1994 and 1995) at Gharbia & Kafr El-Sheikh Governorates and two seasons (1993 & 1994) for Beheira Governorate, to facilitate the graphical estimation for the population cycles in each locality separately. It appears that reliable appearance of *Pectinophora gossypiella* moths took place during March, April and May thus forming the suicidal emergence. This is mainly due to the fact that this insect is oligo-phagous in addition to the emergence of moths at that time took place in the absence of favorable plant stage of cotton. Accordingly, this emergence is regarded as suicidal. The weekly numbers of captured pink bollworm moth determined by sex pheromone traps indicate that the first emergence period demonstrated unreliable changes in the population cycles of moths, while the second period underwent four obvious peaks of four overlapping generations in the three tested localities.

INTRODUCTION

It is a well known fact, that precise knowledge of appropriate dates of first and last dates of moth appearance from the one hand, and number and duration of its field generations from the other is considered as a true basic informations for (IPM) integrated pest management programmes. The pink bollworm, *Pectinophora gossypiella* (Saunders) is common occurred in cotton fields of Egypt feeding on different stages of growth for a fairly long period. This period could be extended for about 4-5 months, possibly from early June to late October. In fact, this continuous availability of oviposition and feeding sites, through the two periods of activity and extremely helps this pest in building up a serious large sized populations, thus causing potential damage. Accordingly, testing the changes in the seasonal abundance of this insect in the different localities seems to be of quite importance. The present study was dedicated to estimate the changes in the population density of pink bollworm

moths commonly occur in cotton fields. The number and duration of bollworm generations were estimated by simply adopting two methods, i.e. the calculation of accumulated numbers of captured male moths (Audemard & Milaire 1975 and Iacob (1977) and by simply tracing the seasonal activity curves of bollworm moths (determined by sex pheromone traps) from which the distinct bell-shaped peaks might be considered as overlapping generations.

MATERIALS AND METHODS

Three field experiments (two for transplanting cotton by seedlings and one for cotton sowing by seeds) were carried out at Gemeiza (Gharbia Governorate) and Sakha (Kafr El-Sheikh Governorate) for three successive seasons (1993, 1994 and 1995) to estimate the approximated numbers and durations of cotton pink bollworm, *Pectinophora gossypiella* (Saunders) field generations, using Delta sex pheromone traps. In Noubaria (Beheira Governorate) the trials were completed but for only two seasons (1993 and 1994).

Sex pheromone traps

In Gharbia and Kafr El-Sheikh Governorates, 3 Delta baited sex pheromone traps were set in cotton fields during three successive seasons. The traps were situated in cotton growing areas, chosen for the field trials. In Noubaria, El-Beheira Governorate, only 2 sex pheromone Delta traps were situated in two selected cotton growing areas. The traps were fixed on metal bars, just above cotton plants. The traps were baited with the specific synthetic pheromone formulated in polyethelene vials. The pheromone capsules were replaced every 2-3 weeks by fresh ones. The adhesive sheet was also changed every three days, and the number of male moths were counted.

Every vial is containing 1 mg of the active ingredient of the synthetic pheromone. Humel *et al.* (1973) and Bierl (1974) indicated that 1: 1 mixture of (Z,Z) and (Z,E)-7,11 hexadecadien 1-01 acetate was the most attractive ratio of the two principle isomers of gossyplure for PBW.

Calculating the number and duration of Pink bollworm, *Pectinophora gossypiella* (Saunders) field generation moths

The approximated numbers and durations of the annual field generations of pink bollworm, *Pectinophora gossypiella* (Saunders) moths were worked out depend-

ing on the weekly catch figures, and confirmed by adopting Audemard & Milaire (1957) and Iacob (1977) formula, using semi-Gaussian paper (scale Gouss) from which the number of field generations was represented by regression lines.

RESULTS AND DISCUSSION

Gharbia Governorate

The first generation: Table 1 determined that the PBW male moths of this first generation in 1993 started to appear in the traps with reliable numbers during the second half of March for the three tested seasons. A few number of moths resulting from this 1st generation survived, thus forming the next and most economically important period of activity. An integration of the seasonal activity curves indicate that the duration of this period of activity lasted for about 11-12 weeks.

The second generation: The moths of this generation started to appear in cotton fields during the third week of May 1993 and one week later in 1994. For 1995, it appeared one week earlier than 1993. The moths continued to occur up to the 1st half of August 1993 and the 2nd half of the same month for 1994.

The third generation: The first appearance of the moth of this generation took place around the 2nd half of June of the three studied seasons and continued up till the first half of September. The duration of this generation lasted for 10-11 weeks.

The fourth generation: The duration of this generation extended 9-11 weeks from early August 1994 & 1995 and on the third week of the same month for 1993, up to the 1st half of November, thus lasting for 10 weeks. It was observed that a small portion of the generation's larvae entered the stage of diapause.

The fifth generation: This generation was first occurred in Gharbia cotton fields from the 1st half of September. Their existence in the field continued for about 10-11 weeks, Table 1. Nearly all the larvae of this generation turned into diapause stage in infested green bolls which usually remain attached to dried cotton stalks.

Kafr El-Sheikh Governorate

First generation: As shown in Table 2, the possible first appearance of pink

Table 1. Approximate number and duration of *Pectinophora gossypiella* generation moths during 1993, 1994 and 1995 seasons at Gharbia Governorate.

Period of Activity	generation number	1993			1994			1995		
		Duration of generation		Duration in weeks	Duration of generation		Duration in weeks	Duration of generation		Duration in weeks
		From	To		From	To		From	To	
First	1st	3rd week of Mar.	2nd week of Jun.	11	3rd week of Mar.	2nd week of Jun.	12	3rd week of Mar.	2nd week of Jun.	11
		3rd week of May	2nd week of Aug.	12	4th week of May	3rd week of Aug.	11	2nd week of May	1st week of Aug.	10
		3rd week of Jun.	1st week of Sept.	11	4th week of Jun.	3rd week of Sept.	10	2nd week of Jun.	1st week of Sept.	10
Second	4th	1st week of Aug.	week of Oct.	9	2nd week of Aug.	4th week of Oct.	11	2nd week of Aug.	3rd week of Oct.	9
		2nd week of Sept.	1st week of Dec.	11	2nd week of Sept.	1st week of Dec.	10	1st week of Sept.	Week of Dec.	11

bollworm moths in the fields occurred during the second week of March. The reliable occurrence continued to the 1st half of June. The duration of this (suicidal emergence) generation was about 12 weeks, Table 2.

The second generation: The first occurrence of this 2nd generation took place on the 2nd half of May and continued up to the 1st half of August, lasting for 12 weeks duration, Table 2.

The third generation: The duration was 11-12 weeks, i.e. from the 1st half of July in 1993 and 1995 and two weeks earlier in 1994 up to the 1st half of October, table 2. This generation was comparatively the biggest and considered as the most economically important.

The fourth generation: This 4th generation lasted between the third week of August 1993 and two weeks earlier during 1994 and 1995 and continued to the 2nd week of November 1993, 1994 and 1995. The duration of this generation was 11 weeks, table 2.

The fifth generation: The moths of this generation were first observed during late September and continued up to early of December showing 10-11 weeks. A great portion of this 4th generation's larvae entered the diapause stage.

Beheira Governorate

The first generation: As shown in Table 3, it started from the second half of March 1993 and one month later for 1994. The occurrence of this 1st generation continued in the following months, then decreased sharply during the second half of May and the 1st half of June, respectively. The total duration was about 12 weeks.

The second generation: It lasted for 10 weeks, Table 3, from late May and extended to the end of August.

The third generation: The male moths of this generation were first captured during the 2nd half of July in 1993 and two weeks earlier in 1994. Its existence continued to early October for 11 weeks duration.

The fourth generation: The duration of this generation continued from the 1st half of August and extended in reliable numbers up to mid-October in 1993 and November 1994. A considerable number of larvae turned to diapausing stage during October and November months.

Table 2. Approximate number and duration of *Pectinophora gossypiella* generation moths during 1993, 1994 and 1995 seasons at Sakha, Kafr El-Sheikh Governorate.

Period of Activity	generation number	1993			1994			1995		
		Duration of generation		Duration in weeks	Duration of generation		Duration in weeks	Duration of generation		Duration in weeks
		From	To		From	To		From	To	
First	1st	2nd week of Mar.	1st week of Jun.	11	2nd week of Mar.	2nd week of Jun.	12	2nd week of Mar.	3rd week of Jun.	11
		4th week of May	4th week of Aug.	12	2nd week of May	2nd week of Aug.	12	3rd week of May	3rd week of Aug.	12
	3rd	2nd week of July.	2nd week of Oct.	12	4th week of Jun.	1st week of Oct.	11	1st week of Jul.	4th week of Sept.	11
		3rd week of Aug.	2nd week of Nov.	11	1st week of Aug.	1st week of Nov.	11	1st week of Aug.	1st week of Nov.	11
	5th	2nd week of Sept.	Week of Dec.	11	4th week of Sept.	Week of Dec.	10	1st week of Oct.	2nd Week of Dec.	10

Table 3. Approximate number and duration of *Pectinophora gossypiella* generation moths during 1993 and 1994 seasons at Beheira Governorate.

Period of Activity	Generation number	1993			1994		
		Duration of generation		Duration in weeks	Duration of generation		Duration in weeks
		From	To		From	To	
First	1st	4th week of Mar.	3rd week of Jun.	11	3rd week of Mar.	2nd week of Jun.	12
Second	2nd	4th week of May	3rd week of Aug.	11	1st week of May	4th week of Aug.	11
	3rd	3rd week of July.	2nd week of Oct.	11	1st week of Jun.	1st week of Oct.	12
	4th	1st week of Aug.	3rd week of Oct.	10	3rd week of Aug.	2nd week of Nov.	11
	5th	3rd week of Sept.	3rd Week of Dec.	12	4th week of Sept.	3rd Week of Dec.	11

Table 4. Approximate number and duration of *Pectinophora gossypiella* field generations during three tested combined seasons (1993, 1994 and 1995) at Gharbia.

Period of Activity	Generation number	Duration of generation		Duration in weeks	Number of moths/trap
		From	To		
First	1st	2nd week of Mar.	1st week of Jun.	10	5.5
Second	2nd	1st week of May	1st week of Aug.	11	11.4
	3rd	2nd week of June	1st week of Sept.	10	24.9
	4th	2nd week of July	1st week of Oct.	10	28.2
	5th	2nd week of Sept.	1st week of Dec.	10	19.1

The fifth generation: Moths of this 4th generation occurred in the baited pheromone traps during the 2nd half of September and tended to decrease sharply during December. All the larvae of this generation entered diapause stage up till March of the next year.

The simultaneous changes in the population activity of *Pectinophora gossypiella* moths

The average duration and consequently the size of the pink bollworm generations in each of the three tested localities were estimated depending on the three years data combined aiming to eliminate the effect of the environmental factors on the population density of this insect as far as possible.

The present study was achieved depending on the data for the three seasons to smooth down as far as possible the experimental errors in testing the changes in the population density and the corresponding environmental variations to the minimum.

The following were summarized the aforementioned results obtained for the tested seasons combined in each locality as follows:

The first generation: Data in Tables 4-6 and Figs. 1-3 show that male moths of PBW were first observed as early as the 1st half of March. The duration of this generation lasted for 10 weeks in Gharbia & Beheira and 11 weeks at Kafr El Sheikh.

The population density expressed as number of moths caught/trap/night tended to increase during the following month reaching an average of 5.5, 7.7 and 3.3 moths/night/trap in the Governorates, respectively. This indicate that the occurrence was comparatively high for Kafr El Sheikh (7.7).

The second generation: The moths of this generation were observed in the baited pheromone traps situated in cotton fields, during the 1st week of May in Gharbia and Kafr El Sheikh and one week later in Beheira cotton fields. The moths tended to occur in reliable numbers during the following weeks, but decreased on the second half of July (Gharbia and Kafr El Sheikh) and lasted to the 1st half of August at Beheira. The duration of this generation completed 11 weeks in the three localities, Tables 4-6. The average number of moths caught/night/trap was 11.4, 17.6 and 10.4 for the three mentioned localities, respectively. This results showed that the population density of PBW moths was again the highest at Kafr El Sheikh district.

The third generation: Data reveal the reliable occurrence of moths on the 2nd half of June (Kafr El Sheikh and Beheira). The occurrence continued up to the 1st half

Table 5. Approximate number and duration of *Pectinophora gossypiella* field generations during three tested combined seasons (1993, 1994 and 1995) at Kafr El-Sheikh.

Period of Activity	Generation number	Duration of generation		Duration in weeks	Number of moths/trap
		From	To		
First	1st	2nd week of Mar.	2nd week of Jun.	11	7.6
Second	2nd	1st week of May	4th week of Aug.	11	17.6
	3rd	3rd week of Jun.	3rd week of Sept.	12	31.7
	4th	3rd week of Jul.	2nd week of Oct.	10	37.6
	5th	3rd week of Sept.	2nd week of Dec.	11	22.8

Table 6. Approximate number and duration of *Pectinophora gossypiella* field generations during two tested combined seasons (1993 and 1994) at Beheira.

Period of Activity	Generation number	Duration of generation		Duration in weeks	Number of moths/trap
		From	To		
First	1st	1st week of Mar.	4th week of May.	10	3.3
Second	2nd	2nd week of May	2nd week of Aug.	11	10.4
	3rd	4th week of July.	2nd week of Sept.	11	21.9
	4th	3rd week of Jul.	2nd week of Oct.	11	24.1
	5th	2nd week of Sept.	3rd week of Dec.	12	14.1

of September. the duration of this generation lasted 10 weeks (Gharbia) and two weeks later for Kafr El-Sheikh Governorate. The number of male moths caught/night/trap during this period recorded 31.7 (Kafr El Sheikh), 24.9 (Gharbia) and 21.9 in Beheira. This indicate the strong occurrence of PBW moths at Kafr El Sheikh.

The fourth generation: The moths of this generation were first captured from the 2nd half of July. This generation completed 10 weeks at Gharbia and Kafr El Sheikh, while lasted for 11 weeks in Beheira cotton fields. The population density at Kafr El Sheikh was (37.6), i.e higher than that of either Gharbia (28.2) or Beheira (24.1).

The fifth generation: Data in Table 4-6 and Figs. 1-3 indicate that the reliable occurrence took place during September. The duration extended to the 1st half of December in Gharbia & Kafr El Sheikh, and the 2nd half of the same month at Beheira. This generation completed 10 weeks (Gharbia), 11 weeks for Kafr El-Sheikh and 12 weeks for Beheira Governorates. The recorded number of moths caught/night/trap was 14.1 for Beheira, 19.1 for Gharbia and 22.8 for Kafr El-Sheikh, thus indicating again the strong presence of the PBW moths at Kafr El-Sheikh district.

From the obtained results, it could be concluded, however, that during the three studied years in the three tested localities, two main periods of activity for the pink bollworm moths took place during the whole season. The 1st period started possibly from March and extended up to May and June. The second period lasted from June up to October and November during which the pink bollworm larvae entered the diapause stage up to March of the following year. The 1st period contains only one generation owing to the unsuitability of cotton for feeding in addition to the strong effect of environmental biotic factors prevailing throughout this period.

The 2nd period of activity, however, underwent 4 destructive peaks forming four overlapping generations of moths.

Our findings in general, were in close agreement with the findings of Slosser and Watson (1972), Stern and Sevachenan (1978), Ahmed (1979), Taneja and Jayaswal (1984 & 1986), El-Deeb *et al.* (1987), Gupta *et al.* (1990), Hussein (1990) whom concluded that *Pectinophora gossypiella* (Saund.) underwent 5 generations a year.

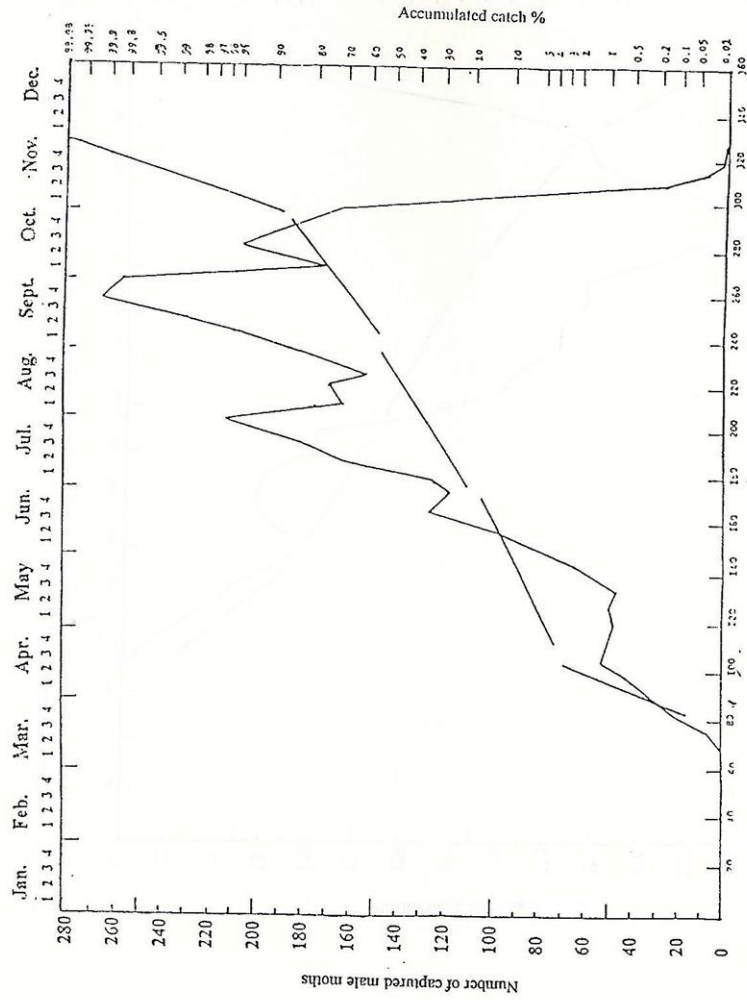


Fig. 1. Approximate and actual average number of field generations of PBW moths (Gharbia - 1993, 1994 and 1995 combined).

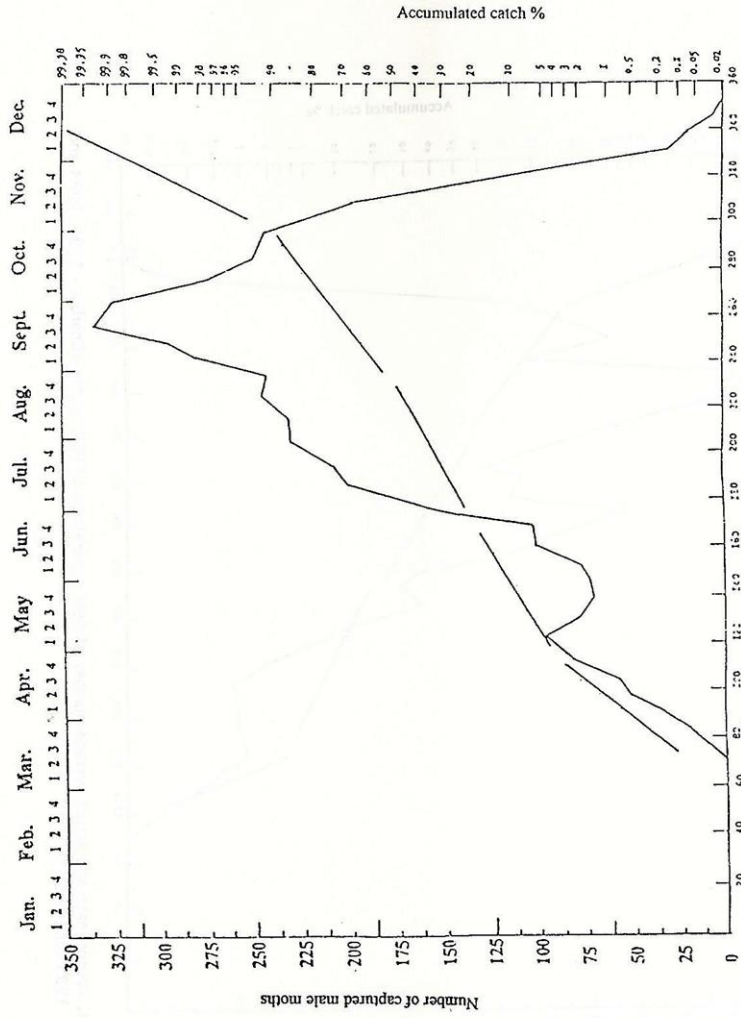


Fig. 2. Approximate and actual average number of field generations of PBW moths (Kafr El-Sheikh - 1993, 1994 and 1995 combined).

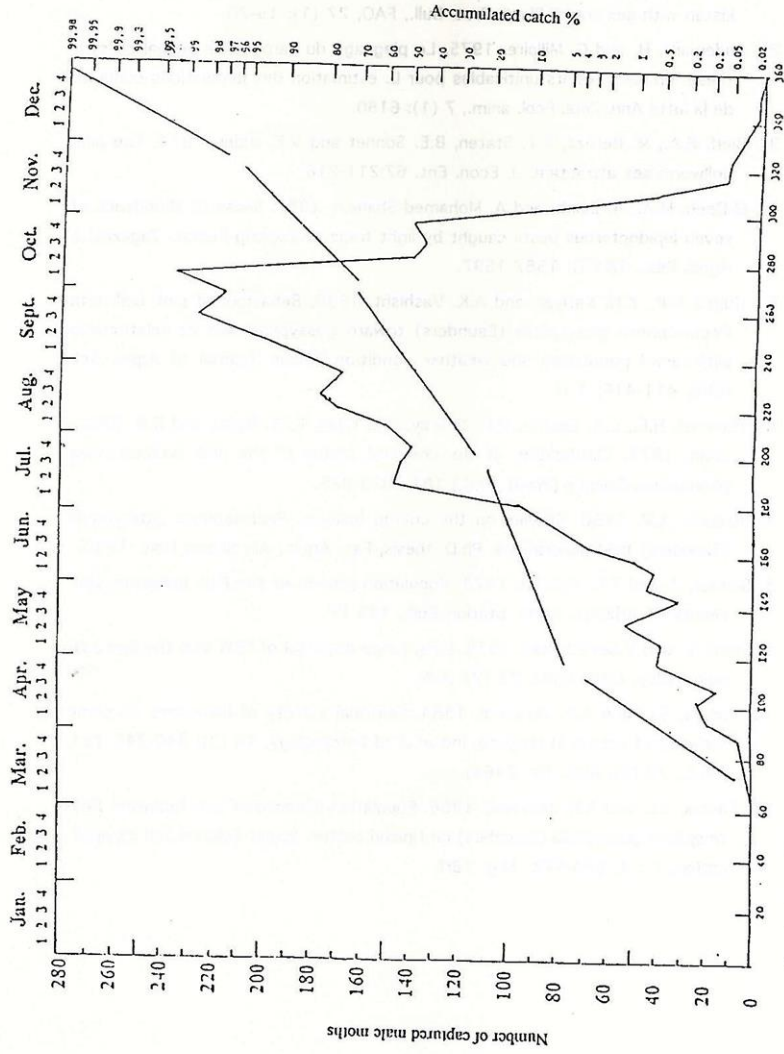


Fig. 3. Approximate and actual average number of field generations of PBW moths (Beheira - 1993 and 1994 combined).

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تقدير عدد أجيال حشرة دودة اللوز القرنفلية علي مدار السنة

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أجريت هذه الدراسة لتقدير عدد أجيال حشرة دودة اللوز القرنفلية وطول مدة الجيل خلال مواسم ١٩٩٣ و ١٩٩٤ و ١٩٩٥ في كل من محافظتي الغربية وكفر الشيخ وخلال موسمي ١٩٩٣ و ١٩٩٤ في محافظة البحيرة. وتوضح الرسوم البيانية دراسة كل منطقة علي حده. وقد تبين أن بداية ظهور هذه الاجيال كان خلال أشهر مارس وأبريل ومايو حيث يكون الجيل الانتحاري (الجيل الاول). ولأن هذه الحشرة محدودة العوائل ويظهر هذا الجيل في وقت غياب الاجزاء الثمرية التي تتغذي عليها اطوار الحشرة ولذا فتهلك معظم حشراتة. ويوضح العدد الاسبوعي للفراشات التي تم اصطيادها بمصائد الفرمونات أن هناك فترة ثانية لنشاط هذه الحشرة تضم أربعة أجيال متداخلة في مناطق التجارب الثلاث وهي الفترة المهمة ذات النشاط والتأثير.