# ANATOMY OF THE REPRODUCTIVE SYSTEM OF *TROPINOTA SQUALIDA* ADULTS

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***Abstract***

In Egypt, family Scarabaeidae comprises several representative species more or less injurious to fruit trees and field crops in newly reclaimed areas. In recent years, the population of *Tropinota suqalida* outbreaked and caused great damage to various plantations. The following points were taken into consideration.

Anatomy of *T. squalida* male and female reproductive system was carried out and the results as follows:

a- The female reproductive system consisted of a pair of ovaries, each ovary consisted of 8 ovarioles, lateral oviduct and a median oviduct, vagina, spermatheca, spermathecal glands, bursa copultrix and an ovipositor.

b- The male reproductive system consisted of a pair of testes, two vasa deferntia with vesicula seminal, a pair of accessory gland with reservoirs and ducts ejaculators. Each testis consisted of eight separate follicles connected by long vasa deferentia to vas deference.

c- The testis areas of males captured in traps were significantly bigger than those newly emerged in laboratory or non-copulated with females. Three peaks of testes areas were recorded during March and April 1997 and 1998. On the other hand, male catch which captures emerged early recorded the least testes areas. This might be due to that most emerged males did not find females, where the sex ratio at this period was males biased.

d- Ten females were dissected weekly from the catch during third week of February until mid-April, 1997 & 1998 seasons and found that:

1- Most of attracted females were copulated before capturing and traps captured copulated females more than non-copulated ones.

2- Percentage of mature eggs of trapped dissected females were less than that immature and it increased only during the first two weeks. These results helped in predicting the number of eggs deposited according to emergence and capturing dates.

Therefore, traps could play an important role to suppress the population density and reduce (directly or indirectly) injuries of insects specially if these were distributed in the early season (January – February).

## INTRODUCTION

The web rose chafer, *Tropinota squalida* Scop. (Coleoptera : Scarabaeidae) was previously known in Egypt as a serious pest to ornamental plants, but was always bellow the economic threshold (Alfieri, 1976). In recent years, the population of *T. squalida* outbreaked and caused great damage to various plantations. Although this scarabaeid pest has a wide host-range (Ali and Ibrahim, 1988), little was known about injurious.

Literature about the reproductive system of *T. squalida* was lacking, but many authors pointed to the structure of the reproductive system of other scarabaeidae beetles such as Stringer (1988&1990) on *Costelytra zealandica* and Jacob (1989) on *Oryctes rhinocerus*.

El-Deeb *et al.* (1987) studied the testis area of *P. gossypiella* male moths captured in sex pheromone traps and found that most of the captured males copulated before capturing in traps. The area of testis was developed by copulation, but declined again at the end of the life span. Three peaks were recorded for the size of testis during June, July and August.

In newly reclaimed areas as in El-Khattara and New-Salhia districts, Sharkia Governorate, Nubaria, Behara Governorate and Ismailia district, Ismailia Governorate, *T. squalida* beetles attacked flowers of all plants ,which emerge during mid January until mid May causing considerable damage and great losses. The flowers of field crops (broad bean, lupine and wheat), fruit trees (apple, pear and citrus), vegetables (cabbage, radish, turnip and rocket) and weeds between (wild mustard and wild radish) were severely attacked by this pest. (Abd-EL fatah, 1991; El-Bassiouny, 1996; Rezk *et al.*, 1998).

## MATERIALS AND METHODS

**Internal anatomy of *T. squalida* adults:** Males and females of *T. squalida* adults were collected from infested trees and field crops at New-Salhia and Sharkia Governorate from March 14 to April 10, 1997.

Captured females and males attracted to funnel blue traps during the intense period *T. squalida* of population activity (from 3rd week of February to mid April) were dissected weekly for copulation studies and the reproductive system of both sexes was removed. The area of testes were determined according to the following stated by Maurizio formula (1954) (Area = $\frac{a \times b}{2} \times \mu$ ), (a = Maximum length b = Maximum

width and $\mu = 3.14$). The female reproductive system was drawn and number of immature and mature eggs in ovaries was counted and spermatheca was examined to recognize if mating was occurred in each dissected female. The mature eggs in dissected copulated females in calyx per each ovary and number of immature ovoum per each ovariole were counted.

## RESULTS AND DISCUSSION

Anatomy of male and female reproductive system of *T. squalida* adults were studied and drawn during 1997

**A. The female reproductive system:** The female reproductive system of *T. squalida,* Figures 1 and 2 consisted of two ovaries; lateral oviducts and a median oviduct, vagina, spermatheca, spermathecal gland, accessory gland, bursa copulatrix and an ovipositor.

**Ovaries:** the two ovaries are positioned in the abdomen. Each ovary consisted of 8 ovarioles which are connected to the swollen calyxes at the ends of short lateral oviducts.

**Ovarioles:** each ovariole is divided into four regions, terminal filament, germarium, vitellarium and the pedicel. The terminal filaments of each ovariole combined to form a suspensory ligament.

**Lateral oviducts:** the ovarioles are connected with the calyx which expanded the anterior end of the lateral oviduct, laterally and dorsally.

**Median oviduct:** the median oviduct appeared more opaque white and more rounded than lateral oviducts. The lateral oviduct joined posteriorly to form the median oviduct.

**Vagina:** its widest point, from where it narrows posteriorly. Antero-dorsally it receives the median oviduct and the apex received the spermatheca and the accessory gland.

**Spermatheca and spermathecal gland:** the spermatheca, spermathecal gland and their ducts are transparent although the spermatheca and spermathecal duct became filled with an opaque white fluid after copulation, the spermatheca is connected to the vagina through the spermathecal duct. Spermathecal accessory gland, is a long tube like structure which joined the vagina separately from the spermatheca.

**The bursa copulatrix:** a sac-like structure dorsally and anteriorly to the vagina, re-

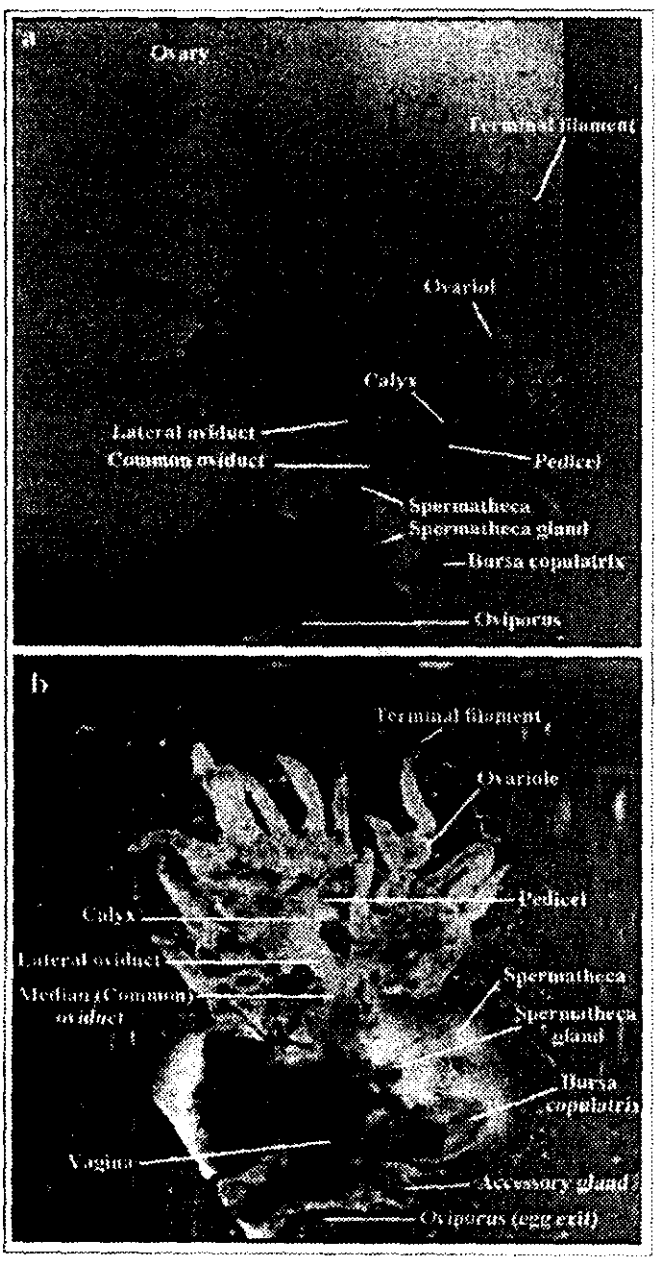


Fig. 1. Female reproductive system of *Tropinota squalida*

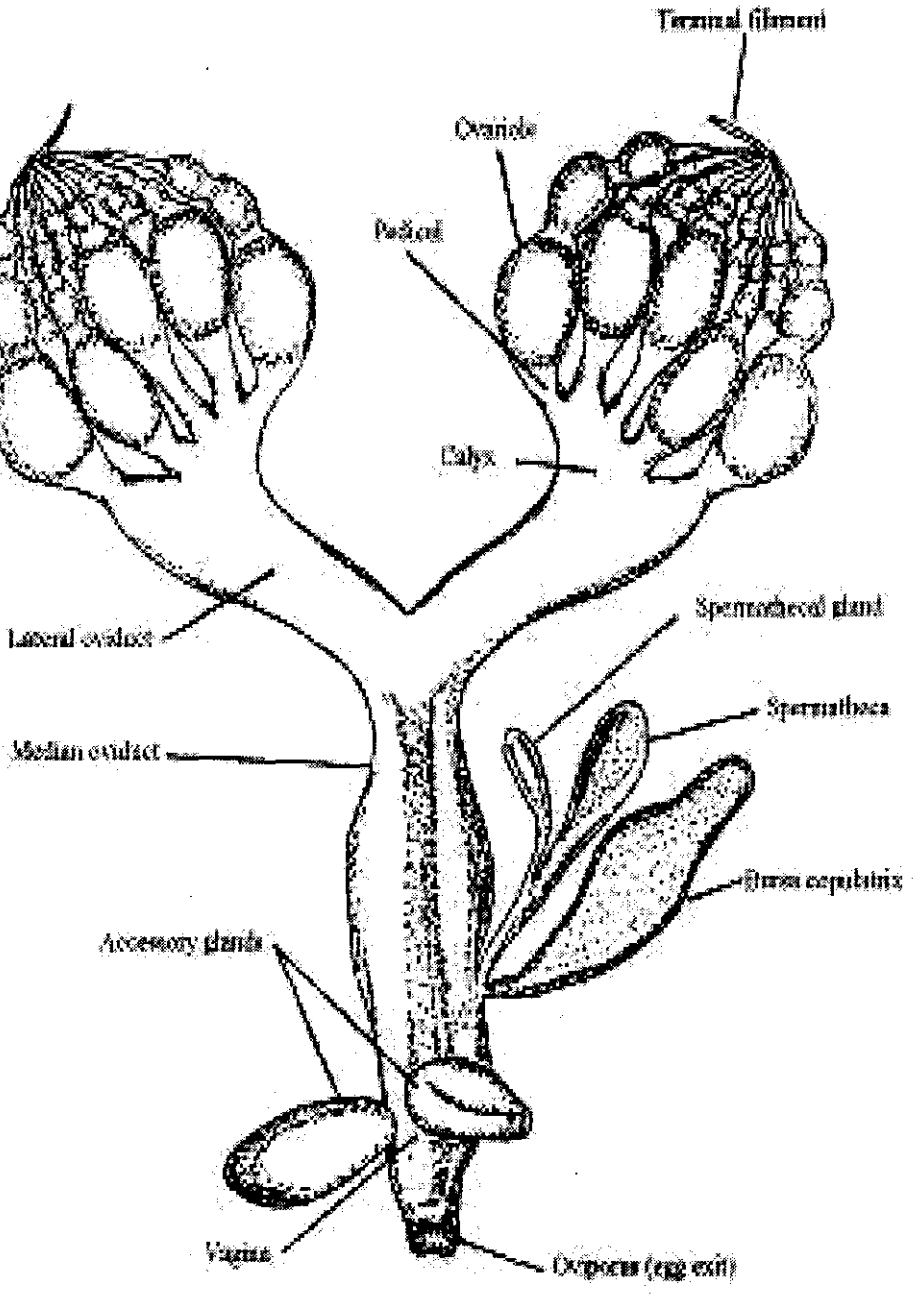


Fig. 2. Female reproductive system of *Tropinota squalida*

**B. The male reproductive system:** The male reproductive system, Figure 3 consisted of a pair of testis, two vasa deferentia with vesiculae seminales, a pair of accessory glands with resevroirs and ejaculatorius ducts. Each testis consisted of eight separate follicles connected by long vasa deferentia to a vas deferens.

**The testes:** testes follicles are opaque white and spherical flattened. Eight follicles generally surrounded by each other's, but in an irregular form group.

**The vasa deferentia:** the vasa deferentia are long and very elastic, thin transparent ducts.

**The vasa deferentia and vesiculae seminales:** the vasa deferentia and seminal vesicles appeared opaque white because secretions and spermatozoa within them, they might also have small translucent white patches, where their contents are clearer. The distal end of each vas deferens is located medial to its cluster of testes follicles. It twisted and coiled irregularly towards the midline, then dilates into a seminal vesicle. Both seminal vesicles run parallel to each other, but did not usually touch until they joined the ejaculatory duct. Each seminal vesicle also laid ventral to an accessory gland reservoir.

**The accessory gland and their reservoirs:** the accessory glands coiled irregularly within the posterior half of the abdomen, proximally, they dilated into short, slightly curved reservoirs that run side by side with seminal vesicles. Accessory glands are usually transparent, but might become translucent white with secretion. Their reservoirs are usually more opaque because of the larger volume of secretion they contain.

**The ejaculatory ducts:** the ejaculatory duct consisted of two regions; most of the ejaculatory duct is opaque white and less than seminal vesicles.

**C. Testis area in *T. squalida* adult male reproductive system:** The results represented in Table 1 and graphically illustrated in Figure 4 showed that the testes areas of dissected adult male captured in traps were significantly bigger than those of the newly emerged in laboratory or non-copulated with females. The mean area of testis in capture males was 4.32 $mm^2$, while it was 0.94 and 1.21 $mm^2$ in newly emerged males under laboratory conditions and those mated once only with females, respectively.

These results indicated that most of trapped males succeeded to mate with females many times before capturing and most of captured male emerged earlier and passed long time before copulation. Also, data cleared that the average of testes area

during 1997 was more than that recorded during 1998, where the average recorded areas were 5.13 and 3.52 $mm^2$, respectively. This difference might be due to the repeated copulated beetles during the first season.

Three peaks of testes areas, 5.98 and 3.81, 5.93 and 9.11, 8.18 and 2.54 $mm^2$ were recorded during 1997 and 1998 on March, 14, 27 and April, 3, respectively.

The highest mating activity (expressed as testis area) was recorded during the period extended from the end of March until the first week of April in both seasons. This period usually have an intense population and maximum mating activity. The total accumulation number of captures had a 22.77% (1997) and 37.02% (1998) and the area of testes reached its maximum, (8.18 $mm^2$ and 9.11 $mm^2$, respectively).

On the other hand, dissection of captured adult males emerged early at the beginning of the season, recorded the least tests areas. This might be due to that most of emerged males did not find females, where the sex ratio during this period was inside male numbers, El-Deeb *et al.* (1987).

**D. Copulation percentage and number of mature eggs in dissected captured females:** The obtained data revealed the following points:

**a- Copulation percentage, Table 2**

1- Most of attracted females were copulated before capturing, where the general mean seasons reached 68.6% and slightly more in the second season (77.1%) than in the first one (60.0%).

2- Traps captured copulated females (13.71) were more than that for non-copulated females(6.29). The efficiency of traps might be due to many seasons such as:

a- Most of females were copulated before capturing and emerged in short interval time and the population had one generation.

b- Trapping females prevented oviposition of copulated females as an indirect injury and suppress the population density (♂ +♀) as a direct injuries (damage). In addition, traps partially prevented virgin females to mate.

3- Males appeared to emerge earlier than females, this behavior helped females to copulate after short period of time of emergence. Mated females deposited their eggs, afterwards during short time (preoviposition). Therefore, traps played an important role to suppress the population and reduced (direct or indirect) injuries of insects specially if traps were distributed during the early season (January – February).

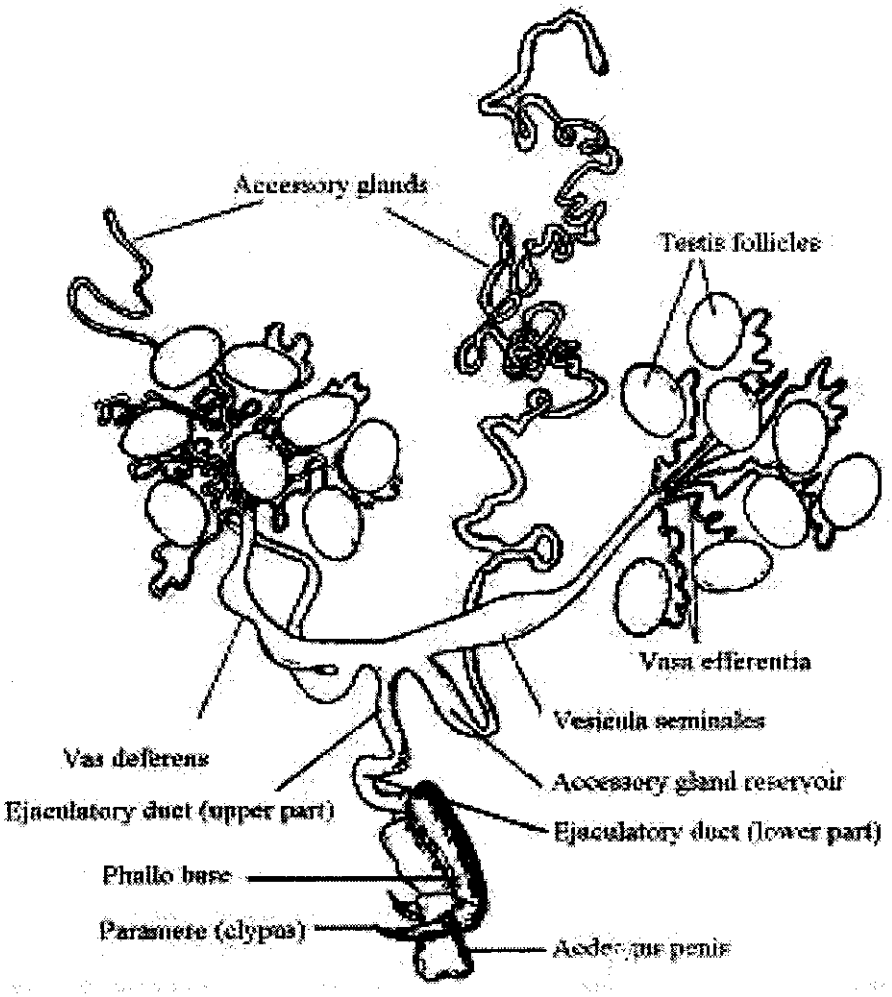


Fig. 3. Male reproductive system of *Tropinota squalida*

Table 1. Testes area of *T. squalida* adult males captured in blue traps (pan & funnel) during wo successive seasons, 1997 and 1998.

| Year / adult No Obs. | Testis area (mm2) | | | | | |
|---|---|---|---|---|---|---|
| | 1997 | | 1998 | | general | |
| | Mean | % | Mean | % | Mean | % |
| 20/2 | 1.35<br>0.99-1.88 | 3.76 | 1.43<br>1.1-1.7 | 5.81 | 1.39 | 4.6 |
| 28/2 | 1.57<br>1.26-1.88 | 4.37 | 3.12<br>1.21-4.71 | 12.68 | 2.34 | 7.73 |
| 14/3 | 5.98<br>2.43-8.17 | 16.64 | 3.81<br>2.36-7.85 | 15.48 | 4.9 | 16.19 |
| 20/3 | 5.91<br>2.83-9.42 | 16.45 | 2.35<br>1.18-3.14 | 9.55 | 4.13 | 13.64 |
| 27/3 | 5.93<br>3.77-10.99 | 16.51 | 9.11<br>4.71-18.85 | 37.02 | 7.52 | 24.84 |
| 3/4 | 8.18<br>6.44-9.73 | 22.77 | 2.54<br>0.91-7.85 | 10.32 | 5.36 | 17.7 |
| 10/4 | 7.00<br>3.30-9.73 | 19.48 | 2.25<br>0.99-5.89 | 9.14 | 4.63 | 15.3 |
| $\bar{X}$<br>s.d | 5.13<br>±<br>2.36 | | 3.52<br>±<br>2.57 | | 4.32<br>±<br>2.01 | |
| | *F. between insects 1.93*<br>*F. between dates 27.297*** | | *F. between insects 0.99*<br>*F. between dates 11.83*** | | | |

Testis area = $\frac{a \times b}{2} \times \mu$ where

a = Maximum lenght

b = Maximum width, $\mu$ 3. 1 4 (formula of maurizio, 1954)

Av. Testis area ($mm^2$) for virgin male (non copulated) 0.94$m^2$

Av. Testis area ($mm^2$) for males copulated one time under lab. Condition 1.21 $mm^2$

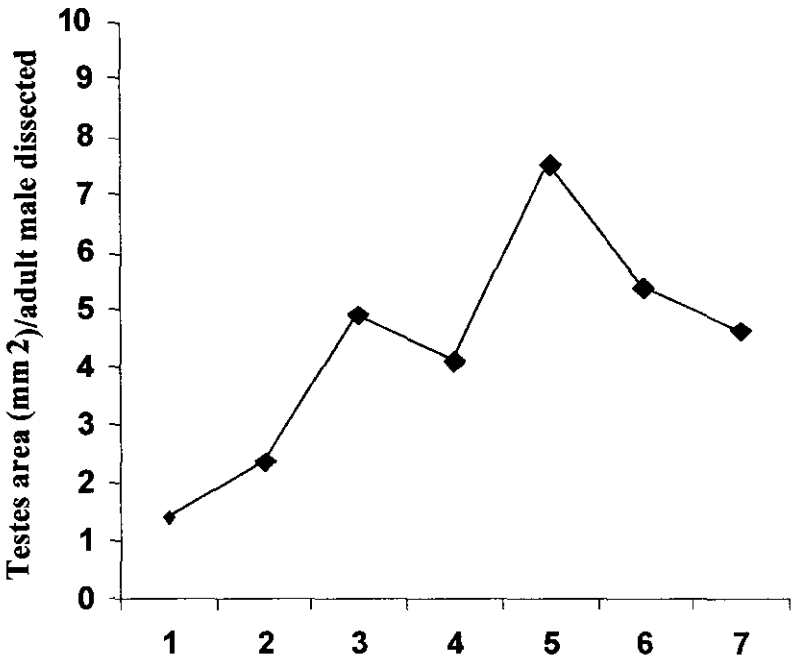


Fig. 4. Testes area in *T. squalida* male reproductive system captured in traps during two seasons (1997 and 1998).

**b- Percentage of mature eggs in copulated captured females:** Obtained data, Table 3 revealed the following

1- The percentage of mature eggs in majority of dissected females were less than that immature and it was only increased during the first two weeks, then it was decreased gradually by the decreasing in the population activity. These obtained results meaning that the oviposition activity of females were increased gradually at the beginning of seasonal activity and majority of females deposited their eggs early before trapping. Therefore, it is necessary to distribute traps at the beginning of the seasonal activity of insects or after emergence to reduce oviposition and the population density of the next season.

2- According to El-Deeb (1992) who reported that the longevity of females under field condition was 31-53 days and the fecundity ranged 18-29 eggs/female. These results can be used as a forecasting method to estimate the probably of deposited the number of eggs according to the emergence and capturing dates, where the females captured in the first two weeks had mature eggs in calyx more than immature in ovarioles. This indicated that captured females in the early season did not deposited eggs yet.

By increasing female age, the immature eggs percentage was increased, this also means that, the attracted females deposited most of their mature eggs.

On the other hand, the efficiency of trapping system is more accurate and suitable to reduce the population density during the next season and also to suppress the damage of the same season, by distributing traps at early season more than that at the late one.

Table 2. Number of copulated *T. squalida* females captured from apple orchards during two successive seasons 1997 and 1998 (in each observation 10 females were dissected)

| Season | 1997 | | | | 1998 | | | | General total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Observ. | Copulation | | T. No | Cop % | Copulation | | T. No | Cop% | Copulation | | T. No | Cop% |
| | Non. | Cop. | | | Non. | Cop. | | | Non. | Cop. | | |
| 20/2 | 3 | 7 | 10 | 70 | 5 | 5 | 10 | 50 | 8 | 12 | 20 | 60 |
| 28/2 | 4 | 6 | 10 | 60 | 2 | 8 | 10 | 80 | 6 | 14 | 20 | 70 |
| 14/3 | 3 | 7 | 10 | 70 | 3 | 7 | 10 | 70 | 6 | 14 | 20 | 70 |
| 20/3 | 4 | 6 | 10 | 60 | 1 | 9 | 10 | 90 | 5 | 15 | 20 | 75 |
| 27/3 | 5 | 5 | 10 | 50 | 2 | 8 | 10 | 80 | 7 | 13 | 20 | 65 |
| 3/4 | 4 | 6 | 10 | 60 | 1 | 9 | 10 | 90 | 5 | 15 | 20 | 75 |
| 10/4 | 5 | 5 | 10 | 50 | 2 | 8 | 10 | 80 | 7 | 13 | 20 | 65 |
| Mean | 4 | 6 | 10 | 60 | 2.29 | 7.71 | 10 | 77.1 | 6.29 | 13.71 | 20 | 68.6 |

Table 3. Number of mature eggs/calyx and immature eggs/ovariole in dissected copulated females captured in traps in apple orchards during two successive seasons 1997 and 1998 (in each observation 10 females were dissected).

| Season | 1997 | | | | 1998 | | | | General total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Observ. | No. of Mature egg in calyx | No Imm. egg in ovariole | Total No. | Mature eggs % | No. of Mature egg in calyx | No Imm. egg in ovariole | Total No. | Mature eggs % | No. of Mature egg in calyx | No. Imm. egg in ovariole | Total No. | Mature eggs % |
| 20/2 | 6.4 | 2.9 | 9.3 | 68.81 | 3.1 | 3.3 | 6.4 | 48.44 | 9.5 | 6.2 | 15.7 | 60.51 |
| 28/2 | 6.3 | 6.6 | 12.9 | 48.80 | 7.6 | 1.3 | 8.9 | 85.40 | 13.9 | 7.9 | 21.8 | 63.76 |
| 14/3 | 6.4 | 8.0 | 14.4 | 44.44 | 5.8 | 4.3 | 10.1 | 57.43 | 12.2 | 12.3 | 24.5 | 49.80 |
| 20/3 | 5.6 | 12.0 | 17.6 | 31.82 | 7.2 | 5.5 | 12.7 | 56.70 | 12.8 | 17.5 | 30.3 | 42.24 |
| 27/3 | 3.0 | 10.4 | 13.4 | 22.39 | 3.8 | 4.8 | 8.6 | 44.19 | 6.8 | 15.2 | 22.0 | 30.91 |
| 3/4 | 5.0 | 12.0 | 17.0 | 29.41 | 1.6 | 6.8 | 8.4 | 19.05 | 6.6 | 18.8 | 25.4 | 25.98 |
| 10/4 | 6.3 | 8.8 | 15.1 | 41.72 | 7.5 | 11.3 | 18.8 | 39.89 | 13.8 | 20.1 | 33.9 | 40.71 |
| Mean | 5.57 | 8.67 | 14.24 | 39.12 | 5.23 | 5.33 | 10.56 | 49.53 | 10.8 | 14.0 | 24.8 | 43.55 |

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# تشريح الجهاز التناسلى لجعل الورد الزغبى

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ينتشر فى المناطق المستصلحة حديثاً فى بعض أنواع الجعال التابعة لعائلة الجعال من رتبة غمدية الأجنحة والتى تسبب كثيراً من الأضرار للزراعات المصرية. أجريت هذه الدراسة المعملية عامى ١٩٩٧ ، ١٩٩٨ على جعل الورد الزغبى وهو من أكثر الآفات ضرراً لمناطق الإستصلاح بمحافظتى الشرقية والإسماعيلية وكانت النتائج كالآتى :

( أ ) تشريح ووصف ورسم الجهاز التناسلى للأنثى : يتكون من زوج من المبياض كل مبيض يحتوى علي ٨ فريعات مبيضية وقناتين جانبيتين وقناة عامة والمهبل والقابلة المنوية وغدة القابلة والغدد المساعدة وغرفة التلقيح وفتحة وضع البيض .

(ب) تشريح ووصف ورسم الجهاز التناسلى للذكر : يتكون من زوج من الخصى وعائين ناقلين لكل حويصلة منوية وزوج من الغدد المساعدة مع مخازنها والقناة القاذفة ، وكل خصية تتكون من ثمانية فصوص متفرقة متصلة بقناة منوية طويلة تصب فى الوعاء الناقل الخاص بها .

(ج) مساحة الخصى فى الذكور المنجذبة فى المصائد كانت أكبر معنوياً من مساحات الخصى فى الذكور والخارجة حديثاً فى المعمل ( التى لم تتزاوج مع الإناث ) .تم تسجيل ٣ ذروات سنوية لمساحات الخصى فى عامى ١٩٩٧ ، ١٩٩٨ خلال شهر مارس وأبريل . سجلت الذكور البالغة مبكراً أو المصادة والمشرحة أقل مساحة للخصى ، ويرجع ذلك أن معظم الذكور الخارجة لم تجد إناثاً حيث أن النسبة الجنسية فى هذه الفترة كانت لصالح الذكور .

( د) النسبة المئوية للتلقيح والبيض الناضج للإناث المشرحة الحقلية المصادة بالمصائد : تم تشريح ١٠ إناث أسبوعياً من البالغات الحقلية المصادة خلال الأسبوع الثالث لشهر فبراير حتى منتصف شهر أبريل خلال موسمى ١٩٩٦ / ١٩٩٧ ، ١٩٩٧ ، /١٩٩٧ ١٩٩٨ وكانت النتائج المتحصل عليها كالآتى:

١ - النسبة المئوية للتلقيح : معظم الإناث المنجذبة للمصائد كانت ملقحة قبل الإصطياد ونسبة إصطياد الإناث الملقحة كانت أكثر من تلك فى الإناث غير الملقحة .

٢ - النسبة المئوية للبيض الناضج : بلغت النسبة المئوية للبيض الناضج فى معظم الإناث المشرحة أكثر من البيض غير الناضج فقط خلال الأسبوعين الأولين ، ويمكن الإستفادة من ذلك للتنبؤ لتقدير عدد وبداية وضع البيض المحتمل وتاريخ الإصطياد . لذلك تلعب المصايد دوراً هاماً لتقليل كثافة الحشرة وتقليل الأضرار ( المباشرة وغير المباشرة ) للحشرات خاصة إذا تم نشر هذه المصائد فى بداية موسم التزهير ( يناير - فبراير ).