# BIOLOGICAL STUDIES ON FENNEL WASP, *SYSTOLE* SP. (HYMENOPTERA, EURYTOMIDAE) A NEW RECORD TO EGYPT.

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## INTRODUCTION

Fennel (*Foeniculum vulgare* L.) is one of the umbelliferous belonging to medicinal and aromatic plants which are expected to play an important role in increasing the national income. Fennel is used to produce many kinds of cosmetic compounds and pharmaceutical products such as Babe-ton and Pentamix against cough, common cold and Immuno-stimulant. Essential oil of fennel could be used as repellent of many insects especially mosquitoes under laboratory and field conditions as indicated by Soonii *et al.* (2004). In Egypt, the cultivated area with fennel is about 2180 feddens according to the records of Ministry of Agriculture (2005). These areas are located in Menia, Assiut, Fayoum and Qena Governorates. Recently, one of the hymenopterous wasps (*Systole sp.,* Eurytomidae) has been observed during storage at August and September 2001 on the fennel bags (verbal communication by Hashem 2001). Sample of the adults has been sent for identification to the Natural History Museum in England. Nozes (2002) has indicated that the sample of adults sent for identification is for the fennel wasp *Systole sp. Systole*, has been firstly identified by Pasol (1988), after Walker in 1965, then by Andriescu (1972 -1973) and Andriescu (1982). Patel *et al.* (1986) observed that *Systole albipennis* infesting fennel seeds in the field in Gujarat, (India), adults emerged from the harvested seeds during storage. Santis *et al.* (1989) found that adults of *S. albipennis* were detected on seeds of fennel, parsley and carrot in Chile. Kashyap *et al.* (1994) recorded that infestation of *S. albipennis* on fennel seeds in December and January with maximum seed infestation (up to 17%) in Haryana, India. There is no information available about the biological aspects of these insects, as informed by Nozes (2002), therefore the aim of this study is to bring more information about the biological aspects of this insect, to give the researchers, specialists and producers, the opportunity to deal with this insect pest.

## MATERIAL AND METHODS

Fennel has been cultivated in an area of 400 $m^2$, at the Experimental Agricultural Station, Faculty of Agriculture, Cairo University, during two successive seasons 2003 – 2004 and 2004 – 2005.

Samples of fennel green seeds were taken weekly, starting in the 4th week of March; it means after five months of plantation (on the first of October) and continued up to harvest. Samples consisting of 300 green seeds collected randomly from each replicate (40 rep.). Each replicate of green seeds was exposed to a couple of adults (male and female) of *Systole* sp. for three days as oviposition site and replicated 40 times, supplied by a piece of wet cotton wool to avoid dryness under laboratory conditions (daily minimum temperature 16.1 ± 2.45 ℃, daily maximum temperature 28.18 ± 3.23 ℃ and daily relative humidity % 54 ± 5 %). Daily investigation of fennel seeds was carried out to follow up the development of the different delicate wasp stages, through desiccation of the infested seeds. Eggs were examined in the ovaries to know the size and shape of eggs; this is the only method to examine the eggs, because after egg lying, it was difficult to see the eggs easily. Immature stages were carefully examined daily till adult emergence, the different larval instars was differentiated through the dimensions (width and length) of head capsule. Sex ratio of *Systole* sp. was estimated by storing the infested fennel seed samples in glass jars covered with muslin. The sex ratio was determined by counting the newly emerged male and female. Data were analyzed by using the analysis of variance (ANOVA) and L.S.D as described by Snedecor (1970).

## RESULTS AND DISCUSSION

**The egg stage:**

The eggs of *Systole* sp. are laid singly inside the fennel seeds; the egg is oval in shape and transparent bearing longitudinal shape at the apical portion as an airoscopic plate Fig. (1). Table (1) indicated the average of incubation period of egg stage, which was 2.6 ± 0.5 days.

**The larval stage:**

The larvae are apodous and euocephalous as explained by Pasol (1988) in his work on *Systole foeniculi*. The larva has chewing type of mouth-parts. The larvae of *Systole* sp. have five instars according to the measurements of larval head capsule. Larvae feed inside the seeds.

First larval instar:

The newly hatched larvae have white color. The width of the head capsule ranged from 0.225 to 0.239 mm with a mean of 0.232 ± 0.007 mm (Table 2 and Fig. 2. a1 & b1), while the length ranged from 0.117 to 0.137mm with a mean of 0.127 ± 0.01 mm. The duration of the 1st larval instar ranged between 2.87 and 4.33 days with a mean of 3.6 ± 0.73 days (Table 1).

**TABLE (I)**

Duration of different stages of *Systole sp.* under laboratory conditions.

| Stages | Duration (days) |
|---|---|
| Incubation period | 2.6 ± 0.5 |
| 1st Larval instar period | 3.6 ± 0.73 |
| 2nd Larval instar period | 3.8 ± 0.41 |
| 3rd Larval instar period | 3.6 ± 0.61 |
| 4th Larval instar period | 2.26 ± 0.45 |
| 5thLarval instar period | 2.73 ± 0.7 |
| Total larval duration | 16.06 + 0.7 |
| Pupal duration | 3.66 ± 0.72 |
| Female longevity | 3.41 ± 0.7 |
| Male longevity | 2.75 ± 0.47 |
| Adult longevity | 3.26 ± 0.62 |
| Life cycle | 25.6 ± 0.38 |

Second larval instar:

The second larval instar has cream-white color. The width of the head capsule ranged from 0.268 to 0.274 mm with a mean of 0.271 ± 0.003 mm (Table 2 and Fig. 2. a2 & b2), while the length ranged from 0.153 to 0.161mm with a mean of 0.157 ± 0.004 mm. The duration of the 2nd larval instar ranged between 3.39 and 4.21 days with a mean of 3.8 ± 0.41 days (Table 1).

Third larval instar:

The third larval instar has the same color as mentioned above. The width of the head capsule ranged from 0.308 to 0.316 mm with a mean of 0.312 ± 0.004 mm (Table 2 and Fig. 2. a3 & b3), while the length ranged from 0.172 to 0.198 mm with a mean of 0.185 ± 0.013 mm. The duration of the 3rd larval instar ranged between 2.99 and 4.21 days with a mean of 3.6 ± 0.61 days (Table 1)

Fourth larval instar:

The width of the head capsule ranged from 0.341 to 0.351 mm with a mean

of 0.346 ± 0.005 mm (Table 2 and Fig. 2. a4 & b4), while the length ranged from 0.196 to 0.212 mm with a mean of 0.204 ± 0.008 mm. The duration of the 4th larval instar ranged between 1.81 and 2.71 days with a mean of 2.26 ± 0.45 days (Table 1).

**TABLE (II)**

Length and width of head capsule of the different larval instars of *Systole sp*

| Larval instar | Length (mm) | Width (mm) |
|---|---|---|
| 1st Larval instar | 0.127 ± 0.01 a | 0.232 ± 0.007 |
| 2nd Larval instar | 0.157± 0.004 a | 0.271 ± 0.003 |
| 3rd Larval instar | 0.185 ± 0.013 b | 0.312 ± 0.004 |
| 4th Larval instar | 0.204 ± 0.008 bc | 0.346 ± 0.005 |
| 5th Larval instar | 0.227 ± 0.006 c | 0.397 ± 0.005 |
| F 0.01 | 18.75** | |
| L.S.D 0.01 | 0.031 | |

Means followed with the same letter are not significantly different.

Fifth larval instar:

The width of the head capsule ranged from 0.392 to 0.402 mm with a mean of 0.397 ± 0.005 mm (Table 2 and Fig. 2. a5 & b5), while the length ranged from 0.221 to 0.233 mm with a mean of 0.227 ± 0.006 mm. The duration of the 5th larval instar ranged between 2.03 and 3.43 days with a mean of 2.73 ± 0.7 days.

The total larval duration ranged between 15.36 and 16.76 days with a mean of 16.06 ± 0.7 days as indicated in Table (1). During the cold months in winter, the larvae come in a diapause as indicated by Lamborot *et al.* (1986). Also Pasol (1988), found diapause larvae in Chile during winter.

**The pupal stage:**

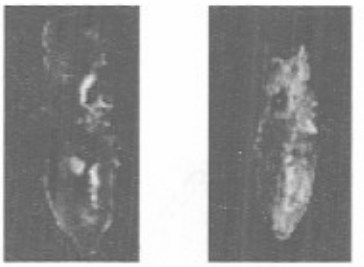
The pupae of *Systole* sp. are free as shown in Fig. (3), the pupa is yellow colored and turns into black color before adult emergence. As indicated in Fig. (4), the abdominal end of female is triangle in shape, while the abdominal end of male is oval. Data presented in Table (1), shows that the pupal duration ranged between 2.94 and 4.38 days with a mean of 3.66 ± 0.72 days, under the laboratory conditions as mentioned above.

**The adult stage:**

The adult is black colored, as shown in Fig. (5). The abdominal end of female is triangle in shape, while abdominal end of male is oval. The adult emerged from the Pupal exuvia remained inside the infested fennel seed until the flowering time of the fennel cultivated in the following season. Adult emerges from the seed

Fig.(1): The egg of *Systole sp.*
(M. 3.3x10x10)


Fig (2): The five larval instars of *Systole sp.*
$a_1$-$a_5$ Head capsule measurements of the different larval instars ( M. 10 X 10 X 3.3 ).
$b_1$-$b_5$ Different larval instars ( M. 10 X 3.3 X3.3 )

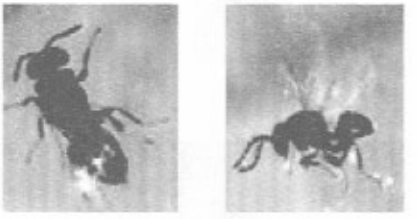


a b

Fig. (3): Anterior (a) and posterior (b) views of Pupae of *Systole sp.* (M. 10 x 3.3)

a b

Fig. (4): Abdominal ends of Female (a) and male (b) pupae (M. 10 x 3.3)



a b

Fig.(5): Adult female (a) and male (b) of *Systole sp.* (M. 10 x 3.3)


Fig.(6): Emergence hole of *Systole sp.*

through an emergence circular hole in fennel seed (Fig. 6). As indicated by Pasol (1988), *Systole* sp. has two generations.

**Adult longevity:**

Data in Table (1) indicated that the female longevity ranged between 4.11 and 2.71 days with a mean of 3.41 ± 0.71 days, the male longevity ranged 3.02 and 2.48 days with a mean of 2.75 ± 0.47 days, so the adult longevity ranged between 2.64 and 3.88 days with a mean of 3.26 ± 0.62 days.

**Life cycle:**

The life cycle (from egg to adult) ranged between 25.22 and 25.98 days with a mean of 25.6 ± 0.38 days. These results are in agreement with those obtained by Patel *et al.* (1986) which indicated that *Systole albipennis* life cycle is 24.5 days.

**Sex ratio**

The investigation of *Systole* sp. population indicated that the sex ratio of males to females is 1: 1.58.

## SUMMARY

Fennel plants *Foeniculum vulgare* L. is one of the umbelliferous belonging to medicinal and aromatic plants which are expected to play an important role in increasing the national income. Many insect pests attack the fennel plants; one of them is the hymenopterous wasp *Systole* sp., which infests the fennel fruits. This is the first study on this insect in Egypt. The eggs of *Systole* sp. are laid singly inside the fennel seeds, the egg is oval and transparent bearing longitudinal shape at the apical portion as an airscopic plate. The incubation period was 2.6 ± 0.5 days. *Systole* sp. has five larval instars. These larvae are apodous and euocephalous. The average of the total larval duration was 16.06 ± 0.7 days. The pupa is free, the average duration of pupal stage was 3.66 ± 0.72 days, and the average of adult longevity was 3.26 ± 0.38. The average of duration of one generation (from egg to adult) was 25.6 ± 0.38 days. Data demonstrated that the *Systole* sp. has two generations per year.

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