

**FEEDING CAPACITY, REPRODUCTION AND COMPETITION BETWEEN THE TWO PREDATORS, *Agistemus exsertus* GONZALEZ (PROSTIGMATA: STIGMAEIDAE) AND *Orius Laevigatus* (FIEBER) (HEMIPTERA: ANTHOCORIDAE) ASSOCIATING WITH THE SPIDER MITE, *Tetranychus urticae* KOCH**

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### ABSTRACT

The prostigmaeid *Agistemus exsertus* and the anthocorid *Orius Laevigatus* co-exist on many economic plants predated upon the tetranychid, *Tetranychus urticae*. The present paper shed light on the bioactivity of these two predators when fed on eggs and immatures of this prey. Competitive study revealed that *A. exsertus* is a potential competitor to *O. laevigatus*; being more voracious, higher in its productivity and higher in its survival rate.

### INTRODUCTION

The prostigmaeid, *Agistemus exsertus* GONZALEZ and the anthocorid, *Orius laevigatus* (Fieber) are potential predatory species, associating with phytophagous mites and small insects on many economic crops in the world and could play a considerable role in control (Barber, 1936; Carayon, 1961; Kelton, 1963; Fauvel, 1971 and 1972; Tawfik and Ata, 1973; Heitmans *et al.*, 1986; Alauzet *et al.*, 1990; Yousef, 1990; Fischer *et al.*, 1992; Nawar, 1992; Berg and Cock, 1993; Abou-Awad and El-Sawi 1993; Yue and Chiders, 1994; Shamsan 1995; Soeib, 1996; Ohno and Kemota, 1997; Sayied 1999).

As far as the present authors are aware, the information on the feeding capacity and reproduction of these two species on the spider mite *Tetranychus urticae* are incomplete. Therefore, the present work was conducted to throw a light on these two aspects, in addition to the competition behavior between them.

### MATERIALS AND METHODS

- 1- Individuals of the predatory mite, *A. exsertus* were firstly collected from several fruit trees in Giza, to rise a stock culture in the laboratory on *T. urticae* as a prey. Eggs, after being deposited on the mulberry leaves were incubated at a constant hygrothermal conditions of 28° C and 62% R.H. After hatching, newly larvae were reared individually till reaching adulthood. Individuals of each instar were supplied with sufficient known number of the prey (eggs or immatures of *T. urticae*) till death. Durations of immature stages, adult longevity and rate consumption were recorded.

- 2- To maintain a laboratory culture of *O. laevigatus*, its adults were firstly collected from sunflower plants in Giza region. Collected adults were grouped, each of six individuals, to be confined in a glass-tube (1x3 inch) with a sufficient amount of eggs and immatures of *T.urticae* as a prey and small pieces of the median vein of lettuce leaves (*Lactuca sativa*) as oviposition sites (Sayied 1999). Lettuce pieces with the inserted eggs were collected daily to be kept in petri dishes (9Cm. in diameter) at 28°C & 62% R.H. till hatching. Newly-hatched nymphs were reared individually in tubes (1x3 Cm) till the adult stage. Each individual of nymphs or adults were provided daily with a sufficient known number of the prey. Durations, Consumption and survival rates and adult longevity were estimated.
- 3- **Reproduction:** five virgin females with three newly emerged males of each of the two predators *O. laevigatus* and *A. exsertus* were used in this experiment. Glass tubes of (4x10 Cm) were used for the former predator where petri-dishes (of 5 Cm in diameter) were used for the latter one. Petri-dishes or tubes were previously provided with sufficient amounts of eggs and immatures of *T. urticae* for adult feeding at 28° C. and 62% R.H. After five weeks, immatures and adults of each predator were counted; five replicates were carried out.
- 4- **Competition:** At 28° C. and 62% R.H., five virgin females and three newly emerged males of each of the two investigated predators were confined together in petri-dishes provided with-sufficient amounts of eggs and immatures of *T. urticae*. Pieces of the median veins of lettuce leaves were also placed for *O. laevigatus* deposition and mulberry leaves for *A. exsertus* deposition. After five weeks, immatures and adults of each predator were counted. Five replicates in this experiment were carried out.

## RESULTS AND DISCUSSION

### 1- Duration and Consumption rate of *A. exsertus*:

Data showed that durations of the different stages of *A. exsertus* were significantly affected by the prey used; eggs or immatures of *T. urticae*. In association with eggs and immatures of the prey, the durations of the larva were 2.4 and 2.8 days, the protonymph 2.6 and 2.4 days and the deutonymph were 2.6 and 3.0 days. The total nymphal period averaged 7.6 and 8.4 days, respectively (Table 1); being significantly ( $P \leq 0.5$ ) shorter when fed on the prey's eggs. However, the longevity of both sexes were shorter in case of feeding on eggs than on immature stages; being in respective 19.3 and 16.3 days, opposed to 21 and 17.3 days for females and males, respectively (Table 1). Statistically, significant differences ( $P \leq 0.05$ ) existed between data reported for the longevity of both sexes and two cases of feeding.



In association with the prey's eggs, the total number of eggs consumed during the larva, protonymph and deutonymph were in respective 6.5 , 11.1 and 18.1 eggs; a total of 35.7 eggs was reported. The respective daily consumption rates were 2.6, 4.3, 6.9 and 4.6 eggs. When fed on the prey's immatures, the corresponding figures were 9.7, 11.0, 19.4 and 40.1 individuals for the total consumption and 3.4, 4.4, 6.4 and 4.7 individuals for the daily consumption rate (Table 1). As for the adult stage, the total numbers of eggs consumed by the female and male were in respective 167.5 and 119.6 eggs, with a daily rates of 8.7 and 7.3 eggs, respectively. The corresponding figure when using the prey's immatures were 140 and 105.1 individuals for the total number consumed and 6.7 and 6.1 individuals for the daily rate of consumption. The data showed that females were more voracious than males in the two cases of feeding (Table 1). Statistically, no significant different existed between data reported for the total number of preys consumed by different instars or stages of the predator. In this concern, some authors mentioned that feeding *A. exsertus* on eggs of *Eutetranychus orientalis* (klein) accelerated the development more than did eggs of *T. cinnabarinus* (Abou El Ghor *et al.*, 1969; Afify *et al.*, 1969 ; El Badry *et al.*, 1969 and Zaher *et al.*, 1979). On the other hand, Abou-Awad and E. Sawi (1993) mentioned that eggs of *T. urticae* (= *T. arabicus*) were the best food for *A. exsertus*, resulting to quicker development, longer longevity and higher rate of reproductivity.

## 2- Duration and consumption rate of *O. laevigatus*:

As in case of the prostigmaeid predator *A. exsertus*, the nymphal stadia of *O. laevigatus* were also affected by the type of prey used. In association with *Tetranychus* eggs, the five, nymphal stadia occupied in respective 2.3, 1.8, 2.1, 1.8 and 2.5 days, opposed to 2.6, 2.2, 2.4, 2.2 and 3.3 days when fed on *Tetranychus* immatures. The respective total nymphal periods were 10.5 and 12.6 days; being highly significant shorter ( $P \leq 0.01$ ) when fed on the prey's eggs (Table 1). In both cases of feeding the fifth nymphal stadium was the longest, while the second and fourth ones were the shortest.

Adult longevity was also shorter in case of feeding on eggs than on the prey's immatures. Respective records for females and males were 10.8 and 11.7 days, opposed to 11.3 and 14.1 days. In this concern, Tawfik and Ata (1973) reported a total nymphal period of 13.9 days for *O. laevigatus* when fed on red spider mites at 26° C & 50% R.H. Also Shamsan (1995) reported a period of 21.3 days for this anthocorid when fed on mites at 21.3° C and 69.9% R.H. ; with no significant difference between nymph durations of male and female .

As for the consumption rates of *O. laevigatus*, data on (Table 1) showed that, in association with the prey's eggs, the total number of eggs consumed during the five nymphal stadia were in respective 26.1, 26.5, 47.3, 56 and 81.1 eggs; a total of 237 eggs was reported. The respective daily consumption rates were 11.3, 14.6, 22.8, 31.3, 32.3 and 22.5 eggs. However, when fed on the prey's immatures, the corresponding figures were 25.2, 23.9, 29.3, 44.7, 78.7 and 201.8 individuals for the total consumption and 10.1, 10.6, 12.3, 19.6, 24.2 and 15.4 individuals for the daily consumption rates (Table 1). In case of the adult stage, the total number of eggs consumed by the female and male were in respective 380.2 and 334.6 eggs, with a respective daily rates of 35.2

and 28.6 eggs. The corresponding figure when using the prey's immatures were 312.8 and 273 individuals for the total numbers, consumed and 28.3 and 22.0 individuals for the daily rates of consumption. The females were more voracious than males in case of eggs, while the vice versa occurred with the prey's immatures (Table 1). Statistically, highly significant ( $P \leq 0.01$ ) difference existed between data reported for the total number of preys consumed by different instars and the two sexes of this predator. In this concern, Tawfik and Ata (1973), mentioned that, the feeding capacities of *O. laevigatus* during its various stadia were 34.9, 22.6, 36.3, 52.1 and 141.6 individuals of the red spider mites; unfortunately, they didn't mention what stage of the mite used.

**3- The survival rates:**

This items was estimated for the different immatures of the two predators, *A. exsertus* and *O.laevigatus* when fed on eggs and immatures of *T. urticae* (Table 1). As shown in the table, the final survival rates of *A. exsertus* immatures were 87.4 and 91.1 % when fed on eggs and immatures of the prey, respectively. The corresponding figures reported for *O. laevigatus* were 89.1 and 90.9%. Females and males of *O. laevigatus* showed 100% survival rates in both feeding types, but for *A. exsertus*, these rates were 93.3 and 86.7 % when fed an immatures of *T. urticae*, opposed to 83.3% for both sexes when fed on the prey's eggs.

**4- Reproductive Capacity:**

At 28° C and 62% R.H. The both predators, *A. exsertus* and *O. Laevigatus* recorded high reproduction rates when fed on eggs than on immatures of *T. urticae*. On the other hand, *A. exsertus* showed a significant higher reproduction rate than the anthocorid *O. laevigatus* when fed on either of the two preys (Table 2). For the prostigmaeid predator, the total numbers of emerging progeny were 454.8 and 433.6 individuals when fed on the preys eggs and immatures, respectively. The corresponding figures reported for the anthocorid predator were 186.4 and 178.2 individuals, respectively. By using a mixture of eggs and immatures of *T. urticae*, the predator *A. exsertus* also showed a higher reproductively (561.0 individuals) than the anthocorid *O. laevigatus* (208.8 individuals); being significantly varied.

**Table (2): Reproduction ad Competition of *A. exsertus* and *O. laevigatus* on *T. urticae* at 28°C. & 62% R.H. after five weeks**

Predator	<i>T. urticae</i>	No. of individuals (Adults + immatures)	
		Average	Range
<i>A. exsertus</i>	Eggs	454.8	388-522
	Immatures	433.6	392-503
	Eggs+ Immatures	561.0	444-611
<i>O.laevigatus</i>	Eggs	186.4	171-201
	Immatures	178.2	165-190
	Eggs+ Immatures	208.8	196-234
<i>A. exsertus + O. laevigatus</i>	Eggs	(281.4)-(209)	(244-307)-(182-244)
	Immatures	(210.4)-(176.4)	(193-244)-(150-209)
	Eggs+ Immatures	(302.8)-(283)	(271-324)-(276-301)

**5- Competition between the two predators:**

In this respect, the total number of the resulting progeny was the criterion for the competition between the two investigated predators. Using the prey's eggs for feeding, the emerging adults were 281.4 and 209.0 individuals of *Agistemus* and *Orius* respectively. The corresponding figures when using

the prey's immatures were 210.4 and 176.4 individuals. Using a mixture of the two forms of *Tetranychus* (eggs + immatures), the resulting progenies were 302.8 and 283 for the prostigmaeid and anthocorid predators, respectively. In all cases, the progeny of *Agistemus* was greater than that of *Orius*; the data showed that, *A. exsertus* was a strong competitor in spite of its longer life cycle compared to *O. laevigatus*.

## CONCLUSION

The prostigmaeid *A. exsertus* and the anthocorid *O. laevigatus* co-exist on many economic plants predated upon the phytophagous mite, *T. urticae*. All the afore-mentioned data concerned with the bioactivity of these two predators emphasized that the *A. exsertus* is a potential competitor to the anthocorid *O. laevigatus*. It is more voracious higher in its productivity and higher in its survival rate. In the view of biological control, competition between indigenous predators of a pest has been invoked to explain why some species failed either to become established or to control the pest successfully. Direct effects of competition are generally through to result from a reduction in resource availability either by interference (Hawkins, 1988 and Yan, 1996).

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## كلنا نباع مبارك

### الكفاءة الغذائية والتكاثر والمنافسة بين نوعين من المفترسات هما المفترس *Agistemus exsertus* والمفترس *Orius laevigatus* المصاحبة للعنكبوت الأحمر العادي

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يهدف هذا البحث إلى المقارنة بين الكفاءة الافتراضية ومعدل التكاثر والتنافس بين مفترسين هما المفترس *Agistemus exsertus* التابع لعائلة *Stigmaeidae* والمفترس *Orius laevigatus* التابع لعائلة *Anthocoridae* ، المصاحبين لكاروس العنكبوت الأحمر العادي *Tetranychus urticae* على العديد من المحاصيل ذات الأهمية الاقتصادية ، وذلك للاستفادة من دور هذه المفترسات وأخذها في الاعتبار ضمن برامج مكافحة . وقد أوضحت الدراسة التي أجريت على 28 م ، 62% رطوبة نسبية الآتى:

- 1- لنوع الفريسة تأثير معنوي على فترة نمو الأطوار غير الكاملة والكاملة، ففي حالة المفترس *A. exsertus* فقد سجلت فترة النمو الكلية (7.6 يوما) التهمت خلالها 35.7 بيض بمعدل يومي 4.6 بيضة ومعدل بقاء 87.4% وذلك عند التغذية على بيض العنكبوت الأحمر، بينما عند تغذية المفترس على الأطوار غير الكاملة للعنكبوت الأحمر فقد كانت فترة النمو الكلية (8.4 يوما) التهمت خلالها 40.1 فرد بمعدل يومي 4.7 فرد ومعدل إبقاء 91.1% . بينما في حالة المفترس *O. laevigatus* فقد سجلت فترة النمو الكلية 10.5 يوما التهمت خلالها 237 بيضة عنكبوت أحمر بمعدل يومي 22.5 ومعدل بقاء 89.1% ، بينما عند التغذية على الأطوار غير الكاملة للعنكبوت الأحمر كانت فترة النمو الكلية 12.6 يوما التهمت خلالها 201.8 فرد بمعدل يومي 16 فرد ومعدل بقاء 90.9%.
- 2- تأثرت فترة حياة الإناث والذكور للمفترس *A. exsertus* حيث عاشت أنثى المفترس 19.3 يوما التهمت خلالها 167.5 بيضة بمعدل يومي 8.7 بيضة ومعدل بقاء 83.3% وذلك عند التغذية على بيض العنكبوت الأحمر بينما عند التغذية على الأطوار غير الكاملة فقد التهمت الأنثى 140 فرد خلال 21 يوما بمعدل يومي 6.7 فرد ومعدل بقاء 93.3% - أما الذكر فقد التهم 119.6 بيضة بمعدل يومي 7.3 بيضة خلال 16.3 يوما بمعدل بقاء 83.3% وذلك عند التغذية على بيض العنكبوت الأحمر، بينما عند التغذية على الأطوار غير الكاملة للعنكبوت الأحمر فقد التهم الذكر 105.1 فرد خلال 17.3 يوما بمعدل يومي 6.1 فرد ومعدل بقاء 86.7% - بينما في حالة المفترس *O. laevigatus* فقد عاشت الأنثى فترة أقصر عند تغذيتها على بيض العنكبوت الأحمر وقد استطاعت أنثى المفترس أن تلتهم 380.2 بيضة خلال حياتها (10.8 يوما) بمعدل يومي 35.2 بيضة وذلك عند افتراسها لبيض العنكبوت الأحمر بنما افترسست 312.8 فرد غير كامل للعنكبوت الأحمر خلال حياتها (11.3 يوما) بمعدل يومي 27.7 فرد وكان معدل البقاء لكلا الجنسين 100% عند تغذيتها على البيض أو الأطوار غير الكاملة للعنكبوت الأحمر العادي.
- 3- سجل كلا المفترسين أعلى معدل من التكاثر عند تغذيتهم على بيض العنكبوت الأحمر - وقد أوضحت الدراسة أن المفترس *A. exsertus* معدل تكاثره بصفة عامة أعلى من معدل تكاثر المفترس *O. laevigatus* سواء كانت التغذية على البيض أو الأطوار غير الكاملة للعنكبوت الأحمر - كما سجل المفترس *A. exsertus* أعلى معدل من التكاثر عند افتراسه للبيض والأطوار غير الكاملة للعنكبوت الأحمر معاً حيث بلغ 561 فرد مقابل 208.8 فرد للمفترس *O. laevigatus* تحت نفس الظروف.
- 4- كان للمفترس *A. exsertus* السيادة في العدد عند منافسته للمفترس *O. laevigatus* سواء كان ذلك على ( البيض ) أو (الأطوار غير الكاملة) أو ( البيض والأطوار غير الكاملة معاً) للعنكبوت الأحمر مما يدل ذلك على أن المفترس *A. exsertus* منافس قوى بالرغم من طول فترة حياته بالمقارنة بالمفترس *O. laevigatus* مما يوضح أهمية هذا المفترس كعنصر هام من عناصر مكافحة البيولوجية يجب أخذه في الاعتبار ضمن برامج مكافحة.



Table (1) : Feeding capacity of *A. exsertus* and *O. laevigatus* on eggs and immatures of *T. urticae* at 28° C and 62% R. H.

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كلنا نباع مبارك



## كلنا نبايع مبارك

Third instar	2.1 ± 0.4	47.3 ± 12.2	22.8±2.9	84.6	2.4±0.5	29.3±7.0	12.3±1.2	92.8
Fourth instar	1.8 ± 0.3	56.0 ± 11.6	31.3±5.1	100	2.2±0.5	44.7±9.6	19.6±1.7	91.6

5798

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كلنا نبايع مبارك



## كلنا نبايع مبارك

Fifth instar	2.5 ± 0.5	81.1 ± 19.8	32.3±1.9	100	2.3±0.6	78.7±18.9	24.2±2.1	100
Total	10.5 ± 1.0	237 ± 27.7	22.5±4.2	89.1	12.6±1.0	201.8±19.7	16.0±1.9	90.9
Longevity:								
Female	10.8 ± 1.4	380.2±10.0	35.2±6.6	100	11.3±3.8	312.8±93.9	27.7±3.5	100
Male	11.7 ± 1.5	334.6±66.1	28.6±4.2	100	14.1±4.3	273±70.9	19.4±1.9	100



