LARVAL PARASITISM OF THE LEAF MIDRIB MINER, *COSMOPTERIX PARARUFELLA* REIDL (LEPIDOPTERA: COSMOPTERIGIDAE), AND PARASITOIDS EMERGENCE ON SUGARCANE AT GIZA IN EGYPT.

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Abstract

Larval parasitism of the leaf midrib miner, *Cosmopterix pararufella* Reidl, in Egypt was studied. (*Saccharum officinarum* L.) leaves infested by the leaf midrib miner were collected weekly from untreated fields in Al-Aiat region at Giza govenorate, Middle Egypt, from February 2001 to October 2003. Results indicated that rate of parasitism significantly varied between the three generations larvae. Whereas, the highest rate was recorded in 2001 (24.6 %) whilst during 2001 - 2002 and 2002 - 2003 those values were 17.9 % and 21.2 %, respectively. Four species of larval parasitoids (Hymenoptera), i. e. *Cotesia* (= *Microgaster* and *Apanteles*) *ruficrus* (Haliday) (new record) (Braconidae), *Pnigalio* sp. (new record) and *Tetrastichus* sp. (new record) (Eulophidae) and *Norbanus* sp. (new record) (Pteromalidae) as well as the hymenopterous pupal parasitoid *Podagrion* sp. (new record) (Torymidae) were identified. *C. ruficrus* was the most abundant species which emergence period lasted about 7 months and started mid (2001 and 2002) and late April (2003) till early (2001 and 2003) and mid November (2002) reaching its peak at mid May, late July and mid October. In 2001 and 2002, *Pnigalio* sp. represented about 22 % of larval parasitism emerged, but declined to about 9% in the last year which emerged earlier four months than *C. ruficrus*. The parasitic activity of *Tetrastichus* sp. and *Norbanus* sp. had a peak about (8 %) in 2002, opposed to about 2 % and 4 % recorded in 2003 and 2001 as well as 5% in both years. *Podagrion* sp. emerged only in a few numbers in 2001. *C. ruficrus* seem to be the most promising parasitoids to be used as biocontrol agents against the leaf midrib miner on sugarcane in Egypt.

INTRODUCTION

Cosmopterix pararufella Reidl (Lepidotera Cosmopterigidae) the midrib leaf miner; is a new recorded pest species attacking sugarcane, *Saccharum officinarum* L., at Al-Aiat and Atfieh regions in Giza govenorate, Middle Egypt. Infestation started from early May till late December and reach its maximum during June, whilst moths emerged in spring, summer and autumn generations (El-Serwy 2004 and 2005). Several authors contributed to survey, biology and parasitism of lepidopterous parasitoids on (*Cosmopterix phyllostachysae* Kuroko) in Japan and many noctuid

larvae in Egypt (Hafez, 1947; Togashi, 1974; Hassanein *et al.*, 1984 - 1985 and El-Heneidy & Hassanein 1987). In order to achieve a sustainable control of this pest, a study of its parasites must be involved to select putative agent of biocontrol to be used in the upsets of natural balance.

MATERIALS AND METHODS

Fields infested by *C. pararufella* were selected at Al-Aiat, Giza govenorate, Middle Egypt. Infested leaves were collected weekly from February 20, 2001 till October 24, 2003. The characteristics of infestation were mining tunnels with red-browny color on upper surface of the leaf midrib and appear of longitudinal dried slits on the other side midrib vein. On every collection date, leaves were dissected and larvae assigned in two classes: unparasitized and parasititized by immature parasitoids and those developed to wasps (emerged from parasitic pores). After examination, parasitized and healthy larvae were placed into two plastic bags with the infested leaf pieces for rearing the live larvae and allow the emergencies of parasitoids and moths. Daily inspection was made and the emerged parasitoids were identified and counted. After the end of emergencies, the dried leaf pieces were reexamined and the failed emerged parasitoids were also identified and recorded.

RESULTS AND DISCUSSION

During the sugarcane growing seasons in this study, there were significant variations between the mean rates of parasitism of the leaf midrip miner *Cosmopterix pararufella* Riedl generations larvae (Table 1). However, it was negatively varied in the different seasons and ranged from 17.9 % (2001- 2002) to 21.2 % (2002 - 2003) while the peak 24.6 % recorded in 2001 with a general mean of 20.8 %.

A- Incidence of parasitism on the larvae of :

1- First generation. Parasitoid activity appeared on the overwintering larvae in a low rate (9.7 %) on the third week of February in 2001 (Fig. 1). It declined to 2.8% by mid March, then increased gradually reached its maximum 35.3 % at early May. In 200 1- 2002 and 2002 - 2003 seasons, parasitism started in rates of 17.9% and 8.1% during early and late October reaching 31 % and 19.4 % in the third week of October and December in 2001 and 2002, respectively. It sharply declined to 1.6% and 5.4 % by early December and mid January in 2001 and 2003. Then, increased gradually reaching highest rates of 23.7% and 75% on early and late May in 2003 and 2002.

2- Second generation. Parasitism started in rates of 21.1 % and 13.9 % at early (2001 and 2002) as well as 3.1 % and late May (2003) reaching 25.7 %, 21.9 % and 21.4 % after one (2001 and 2003) and two weeks (2002), (Fig. 2 a). Then, declined

to 9.2 %, 0.7 % and 5.2 % at late May as well as early and late June in the second, first and third years, respectively. It increased progressively reaching peaks of 83.3 %, 76.9 % and 72.7 % on mid and late August in the first and the last two years.

3- Third generation. Parasitism had no obvious trend in the different years. Rates of 20 %, 34.8 % and 17.4 % were observed on the first, the second and the third weeks of October in 2001, 2003 and 2002, respectively (Fig. 2 b). In the next week, it declined to 17.9 % and 5.6 % in the first and the third years, but suddenly increased to 48.5 % opposed to 19.2 % a week later in the second one. Then, increased gradually reaching peaks of 68.9 %, 74.1 % and 91.7 % in the first, the third and the fourth weeks of October in 2003, 2002 and 2001, respectively. In 2003, it decreased to 46.2 % after two weeks.

B-Larval parasitoids. Four larval parasitoids species (Hymenoptera: Chalcidoidae) i. e. Cotesia (=*Microgaster* and *Apanteles*) *ruficrus* (*Haliday*) (new record) (Braconidae: Microgastrinae), *Pnigalio* sp. (new record) *Tetrastichus* sp. (new record) (Eulophidae: Eulophinae and Tetrastichinae) and *Norbanus* sp. (new record) (Pteromalidae) were identified. Table 2 shows the four species emerged in all years presented a fluctuating activity, they were:

1- *C. ruficrus.* This was the dominant species that represented about 68%, 62.5% and 84.3 % of the total parasitoids found in the three successive years, respectively (Table 2). Wasps reared from the overwintering parasitized larvae emerged by mid (2001 and 2002) and late April (2003), (Fig. 3). The emergence period prolonged till early June in all years, but earlier a week in the first year. A distinct peak was attained on the third, the first and the second weeks of April and May in 2002, 2001 and 2003, respectively. Wasps resumed its emergence again on the third week of June and two weeks later in the first and the two next years till early (2001 and 2003) and mid November (2002). Two peaks were attained by late July and mid October in all years, but earlier a week in 2002.

2-*Pnigalio* sp. This species emerged in constant percentage about (22 %) in the first two years, but declined to about 9 % in the third one (Table 2). Wasps emerged in a few numbers by early January, March and May till early June, late April and mid May in 2002, 2001 and 2003, respectively. Its following emergence started at late June, early July and August till early November and December as well as late October in 2002. 2001 and 2003. Maximum numbers were emerged during July, September and October in 2001, 2003 and 2002, respectively (Fig. 4 a).

3- *Tetrastichus sp.* This species represented 8.3 % of the total number of parasitoids found in 2002, but declined to 4.2 % and 1.8% in 2001 and 2003 (Table 2). Wasps emerged in a few numbers and had no an emergence trend in the different

years. It appeared by early April till mid May and a week later in 2001 and 2002. The second emergence observed on mid July and late August till late October and mid November in the second and the first years. In 2003, the emergence period extended from the third week of July to late September. Majority of wasps emerged during April and July in the first and the last two years (Fig. 4 b).

4- *Norbanus sp.* This parasitoid found with a constant percentage about (5 %) in 2001 and 2003, but increased to 7.6 % in 2002 (Table 2). It emerged on late June and August till late August and mid October whereas the detected numbers emerged during these two months in 2002 and 2001, respectively (Fig. 4 c). In 2003, the emergence period prolonged from the third week of July till early November and peaked by August.

C- Pupal parasitoid. One hymenopterous species *Podagrion* sp. (new record) (Torymidae) was identified. It emerged from pupae during November in 2001.

Parasitism rate of the leaf midrib miner showed significant differences between the three generations larvae, but was negatively varied during the seasons sampled in this study. A high variation of larval parasitic activity both in terms of parasitoids and duration of their emergencies was observed. *C. ruficrus* was the most dominant species accounting for about (75 %) of the total number of larval parasitoid emerged in this study. In all years, its emerged period lasted about 7 months and started mid (2001 and 2002) and late April (2003) till early (2001 and 2003) and mid November (2002). Three peaks were attained at mid May, late July and mid October. Such peaks coincides with the maximum emerged moths of *C. pararufella* (El-Serwy, 2004 b). This species parasitized over 50 hosts that feed both internally and externally on plants including: *Pectinophora gosypiella* (Saunders) (Gelechiidae), Agrotis ipsilon (Hufnagel); *Chrysodeixis chalcites* (Esper), *Mythimna loreyi* (Duponchel), *Sesamia calamistis Hampson* and *S. nonagrioides* (Lefebvre) (Noctuidae) and Chilo *zacconius Bleszynski* as well as *Maliarpha* sp. (Pyralidae) in Africa (Walker, 1994). It is a solitary endoparasite of the midrib full grown larvae and wasps emerging from a circular opening made on the infested midrib by the caterpillar. Whereas, it has been recorded as gregarious internal parasite of many noctuid larvae (*Agrotis ipsilon, Leucania lorey* and *Plassia* spp.) in Egypt (Hafez, 1947). All Microgasterinae are koinobiont endoparasites of Lepidoptera and may be gregarious or solitary which number of parasites on a host depends upon the size of host, only a single chalcid for small leaf-mining microlepidoptera caterpillers and many on larger noctuids (Askew, 1971 and Walker, 1994). In the family Eulophidae, the most abundant species was *Pnigalio* sp. representing about 16 % of the total parasitoids collected with emergences from the overwintering larvae starting earlier four months than *C. ruficrus*. Some species of the

genus *Pnigalio* are ectoparasites on the lepidopterous leaf miners belongs to families (Coleophoridae, Cosmopterigidae, Gracillariidae, Heliozelidae, Incurvariidae, Lyonetiidae, Nepticulidae. Tischeriidae and Yponomeutidae) (Togashi, 1974, and Yoshimoto, 1983). However, *Tetrastichus* sp. accounted for about 4 % of the total parasitoids emerged which had a peak of about 8 % in 2002, but ranged between about 2 % and 4 % in 2003 and 2001. Wasps emerged in two periods by early April to late May and from mid July till mid November. Some species of the genus *Tetrastichus* are lepidopterous parasitic parasitoids *T. atriclavus* on (*Chilo sacchariphagus* Bojer) in Mauritus and *T. sokolowskii* on (*Plutella xylostella* (L.)) in Japan (Facknath, 1989 and Wakisaka *et al.*, 1991). The pteromalid species accounted for about 6 % of the total parasitoids emerged in all years. Wasps emergencies started late without an obvious trend at late June, July and August till early November, late August and mid October in 2003, 2002 and 2001, respectively. Two pteromalid species: *Homoporus subniger* (Walker)and *Merisus splendidus* Walker are larval parasitoids of *Glyphipterix simpliciella* (Stephens) on *Dactylis glomerata* L. (Graminae) (Abdullah *et al.*, 1989). *Podagrion* sp. was the only pupal parasitoid emerged in individual numbers at November in 2001. Two species belonging to this genus: *P. philippins* and *P. chinense* are parasitic eggs of two mantid species (*Heirodula patellifera* and *Tenodera aridifolia sinensis*) in China (Sheng and Xu, 1989). Thus, the record of *Podagrion* sp. from a midrib leaf miner is a complete novelty and appears as a new case of morphoparasitism.

In conclusion, *C. ruficrus* seem to be the most promising parasitoid to be used as biological control agent against the midrib miner in Egypt, given that species are used worldwide in biocontrol programs of noctuids (*Spodoptera frugiperda*) in USA and (*Mythimna separate*) in New Zealand (Rajapakse *et al.*, 1985 and Hill, 1988).

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Table 1. Means rate of parasitism of the leaf midrib larvae in 2001, 2001 - 2002 and 2002 - 2003.

Generations of larvae	Means of larval parasitism			General mean
	2001	2001 - 2002	2002 - 2003	
1 st	11.8	11.1	9.7	10.9
2 nd	22.3	23.0	25.6	23.6
3 rd	47.5	39.3	43.1	43.3
General mean	24.6	17.9	21.2	20.8

Table 2. Larval parasitoids collected during 2001, 2002 and 2003.

Family, subfamily and species	No. of collected parasitoids												Total	
	2001				2002				2003					
	Emerged	Failed	Total	%	Emerged	Failed	Total	%	Emerged	Failed	Total	%	No.	%
Braconidae : Microgastrinae *Cotesia = (Microgaster* and *Apanteles) ruficrus* (Haliday)	174	49	223	68.0	113	52	165	62.5	349	108	457	84.3	845	74.5
Eulophidae Eulophinae *Pnigalio* sp.	59	15	74	22.6	35	22	57	21.6	46	2	48	8.9	179	15.8
Tetrastichinae *Tetrastichus* sp.	14	0	14	4.2	22	0	22	8.3	10	0	10	1.8	46	4.1
Pteromalidae *Norbanus* sp.	17	0	17	5.2	13	7	20	7.6	27	0	27	5.0	64	5.6
Total	264	64	328		183	81	264		432	110	542		1134	
%	80.5	19.5			69.3	30.7			79.7	20.3				

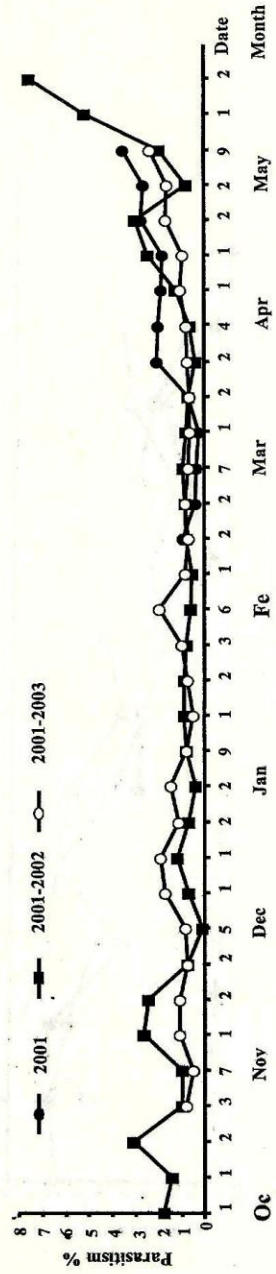

Fig. 1. Incidence of parasitism on the first generation larvae of *C. pararufella* during October- May in 2001, 2001- 2002 and 2002-2003.

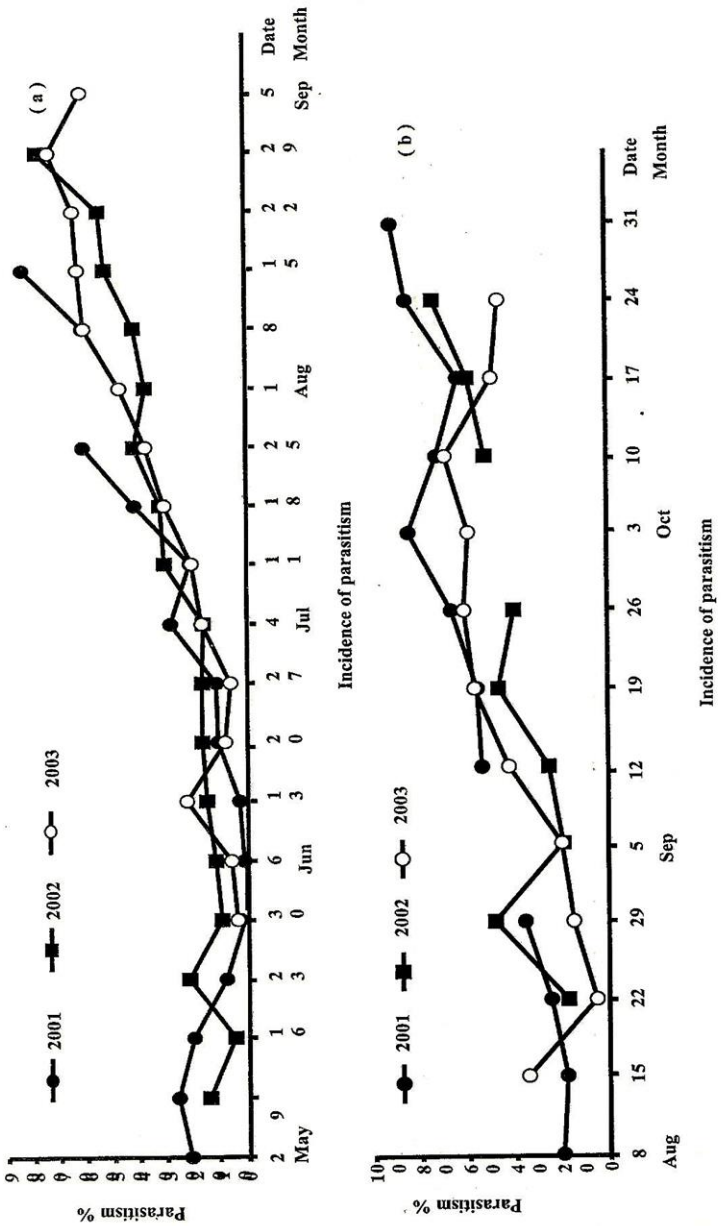

Fig. 2. Incidence of parasitism on the second (a) and the third generations (b) larvae of *C. pararufella* during May- October in 2001, 2002 and 2003.

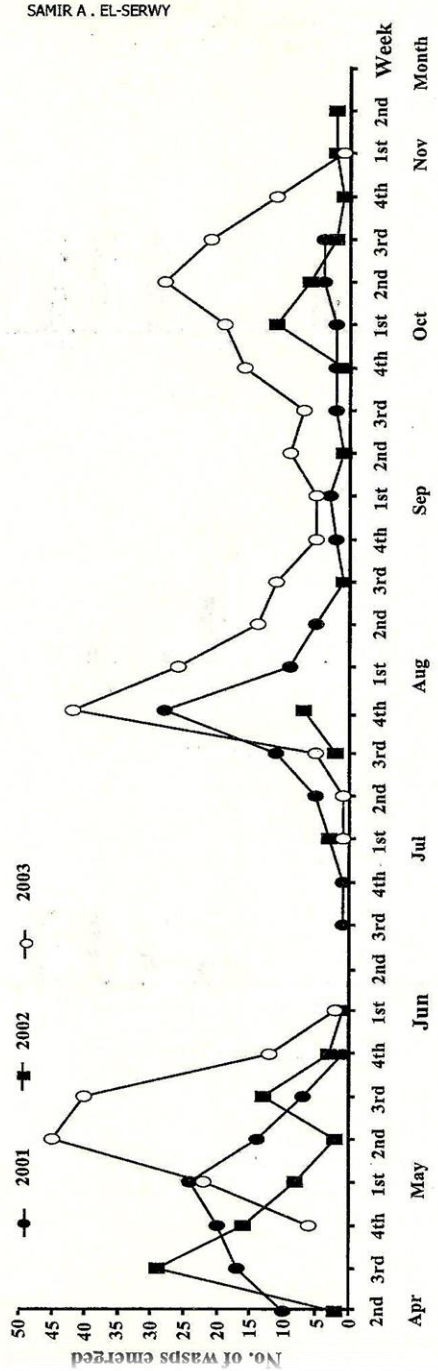

Fig. 3. Distribution of emerged *Apanteles ruficrus* during April- November in 2001, 2002 and 2003.

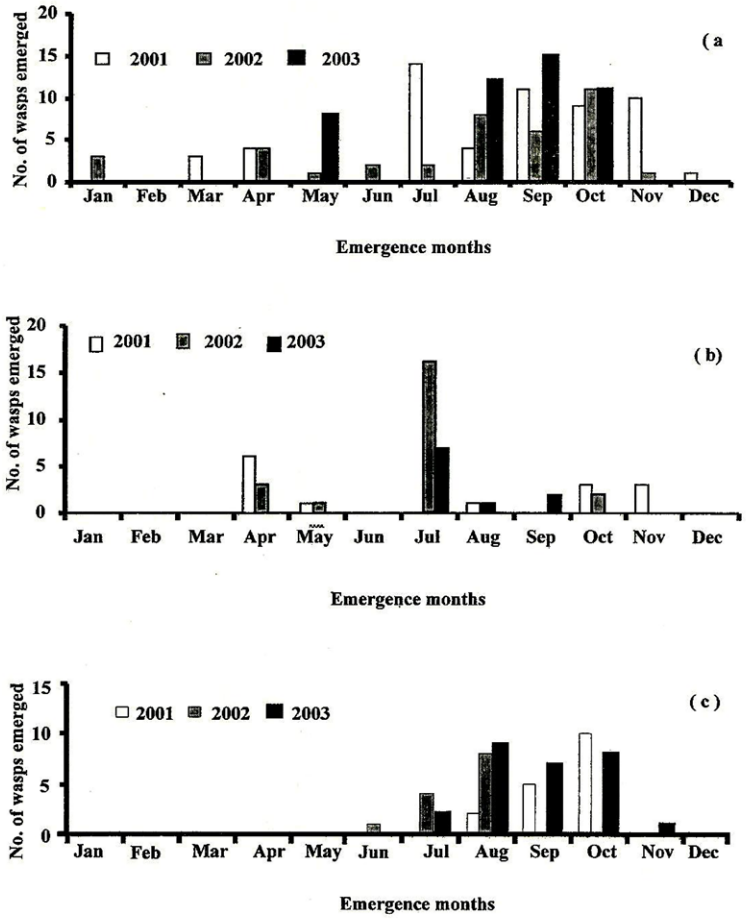

Fig. 4. Emergence of *Pnigalio* sp. (a), *Tetrastichus* sp. (b) and *Norbanus* sp. (c) during the different months in 2001, 2002 and 2003.

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التطفل اليرقى لصانعة أنفاق العرق الوسطي *COSMOPTERIX PARARUFELLA* REIDL وخروج الطفيليات على القصب في الجيزة بمصر.

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تم دراسة التطفل اليرقى لصانعة أنفاق العرق الوسطي *Cosmopterix pararufella* Reidl في مصر. جمعت أوراق مصابة أسبوعيا من حقول قصب سكر غير معاملة في منطقة العياط بمحافظة الجيزة بمصر الوسطي من فبراير ٢٠٠١ إلى أكتوبر ٢٠٠٣. وتشير النتائج المتحصل عليها إلى أن معدل التطفل يختلف وبفروق معنوية بين يرقات الأجيال الثلاثة. سجلت أعلا نسب للتطفل (٢٤،٦%) في عام ٢٠٠١ بينما انخفضت إلى (٢١،٢%) في موسم ٢٠٠٢- ٢٠٠٣ و (١٧،٩%) في موسم ٢٠٠١- ٢٠٠٢. تم تعريف ٤ أنواع من الطفيليات من رتبة غشائية الأجنحة وهى: *Cotesia* (*Microgaster& Apanteles*) *ruficrus* (Haliday) (تسجيل جديد) من عائلة (Braconidae)، *Pnigalio* sp. (تسجيل جديد) و*Tetrastichus* sp. (تسجيل جديد) من عائلة (Eulophidae) و*Norbanus* sp. (تسجيل جديد) من عائلة (Pteromalidae) وكذلك طفيل على العذارى من نفس الرتبة هو *Podagrion* sp. (تسجيل جديد) من عائلة (Torymidae). وجد أن النوع *C.ruficrus* هو ألأكثر شيوعا وتستمر فترة خروجة ٧ أشهر حيث تبدأ من منتصف (٢٠٠١ و ٢٠٠٢) وأواخر أبريل (٢٠٠٣) وحتى أوائل (٢٠٠١ و ٢٠٠٣) ومنتصف فبراير (٢٠٠٢) وتصل ذروتها في منتصف مايو وأواخر يوليو ومنتصف أكتوبر. ويمثل النوع *Pnigalio* sp. حوالي ٢٢% من الطفيليات الخارجة في العامين الأول والثاني، لكنها انخفضت إلى ٩% في العام الأخير حيث تخرج مبكرة بأربعة شهور مقارنة بالنوع *C.ruficrus*. أما النوعان *Tetrastichus* sp. و *Norbanus* sp. فتصلا ذروة نشاطها (٨%) في عام ٢٠٠٢ مقارنة ب (٢% و ٤%) في عامى ٢٠٠٣ و ٢٠٠١ للنوع الأول و (٥%) في كلا العامين للنوع الآخر. بينما تواجد النوع *Podagrion* sp. بأعداد فردية في نوفمبر عام ٢٠٠١. يعتبر النوع *C.ruficrus* من أنشط الطفيليات والتي يمكن استخدامها في المكافحة الحيوية ضد تلك الآفة على القصب في مصر.