Egyptian Journal of Biological Pest Control

RESEARCH Open Access

Deroplax silphoides (Thun.) (Hemiptera: Scutelleridae), a new recorded insect species on *Dodonaea viscosa* (L.), and its egg parasitoid *Trissolcus basalis* Woll. (Hymenoptera: Scelionidae) in Egypt

Monir M. El Husseini[1*], Salama I. Askar[2] and Ata A. Ata[1]

Abstract

The scutellerid shield bug, *Deroplax silphoides* (Thun.) (Hemiptera: Scutelleridae), is a new recorded insect species (in Egypt) attacking the ornamental plant, *Dodonaea viscosa* (L.). The bug feeds by sucking sap from flowers and green seeds of this plant and sometimes from the very tender young apical leaves. Abundance of both the bug and its associated egg parasitoid *Trissolcus basalis* Woll. (Hymenoptera: Scelionidae) showed two generations of the bug peaking at the end of March and end of April. Thereafter, the non-parasitized individuals entered a summer aestivation till spring of next year synchronizing with the flowering time of its host plant *D. viscosa*. The scelionid egg parasitoid, *T. basalis*, showed also two generation on eggs of the bug in March and April. The parasitism rate reached 68.4 and 70.5% in 2016 and 2017, respectively. The life time fecundity of mated females reached an average of 49.5 ± 2.1 eggs. Adult life span for male and female parasitoid was 19.3 ± 1.0 and 23.5 ± 1.2 days, respectively. Some other biological aspects of the bug and its parasitoid were studied.

Keywords: *Deroplax silphoides*, *Dodonaea viscosa* , *Trissolcus basalis*, Biology, Egypt

Background

The shield or jewel bug, *Deroplax silphoides* (Thun.) (Hemiptera: Scutelleridae), was seen for the first time in Egypt in large numbers on flowers of the ornamental plant *Dodonaea viscosa* (L.) (Fam. Sapindaceae) at Giza governorate in 2006 by the first author. A sample was sent to Dr. Jürgen Deckert at Museum für Naturkunde Berlin who identified the bug as *Deroplax* sp. According to Ahmad et al. (1988), it was identified as *Deroplax silphoides* (Thunberg); the same species exists in Pakistan (Ahmad et al. 1988). Species of the genus *Deroplax* inhabits the Oriental region and was recorded in Bangladesh (Scott 1990), the Paleartic in Pakistan (Ahmad et al. 1988), Saudi Arabia (Göllner-Scheiding 2006 and El Hawgary et al. 2013) and Israel (Novoselsky et al. 2015). It was also reported from the Afrotropic region in Madagascar, South Africa (Leston 1953), Senegal Somalia, and Ethiopia (Schoutenden 1904 and Kirkadly 1909). Among other scutellrid species, it is considered an invasive insect pest in some countries (Javahery et al. 2000). On the other hand, Scott (1990) mentioned it as a potential biocontrol agent against the devil's weed *Trbulus terrestis* L. in South Africa.

As Novoselsky et al. (2015) cited a photo in their publication on *D. silphoides* titled "egg mass on fruit capsule at time of hatching", we realized that it was for egg mass all parasitized by *Trissolcus basalis* Woll (Hymenoptera: Scelionidae), recognized through the rounded exit hole cut by emerging adult wasp, beside the presence of an adult wasp half-emerged from an egg. Thus, it attracted our attention to study the biology of *D. silphoides* and parasitism on egg masses with *T. basalis.*

* Correspondence: monir.elhusseini@agr.cu.edu.eg; monirelhusseini45@gmail.com
[1]Center of Biological Control, Faculty of Agriculture, Cairo University, Giza, Egypt
Full list of author information is available at the end of the article

The scelionid egg parasitoid *T. basalis* is wide spread in Egypt on eggs of the pentatomid bugs, especially the green bug, *Nezara viridula* (L.), on different crops (El-Husseini et al. 2006).

Materials and methods

Fluctuation of *D. silphoides* and its egg parasitoid

The *D. viscosa* fens around the garden of Biological Control Center, Faculty of Agriculture, Cairo University, Giza, Egypt, were inspected weekly beginning by flowering time from March until May/June in both years 2016 and 2017. The flowers and fruit bunches (green seeds) were inspected by naked eyes, and number of eggs in each egg mass was counted and left on its place on the plant. The location of each egg mass on plant was labeled by date whatever the eggs are still developing or already hatched. Numbers of parasitized and non-parasitized eggs were counted, and parasitism rate was calculated. Also, 25 bunches of flowers or green fruits (seeds) were randomly sampled *on sito*, and numbers of bugs (adults and nymphs) were calculated and left on the plants. The newly hatched nymphs aggregate in large numbers on the flowers associated with adults. In fact, there is a phenomenon of maternal care in *D. silphoides* that contributes to such aggregations by feeding on sap from *Dodonaea* flowers and green seeds. Aggregation of different hemipteran bug species was mentioned early by Dodd (1904) and recently by Tallamy and Schafeer (1997), Tallamy (1998) and Monteith (2006).

Durations of bug stages

Adults of *D. silphoides* were easily collected by hand from flowers and green fruits of *Dodonaea* in a 1-l glass and transferred to the laboratory. They were placed in cages made of wire frames (15 × 15 × 30 cm) clothed by fine lady stockings provided with a *Dodonaea* flower bunch, which its cut end was placed in water within a glass tube (1 × 3 in.) to keep the plants fresh as long as possible. The encaged flowers or green seeds were inspected daily for egg mass laying. Laid egg masses were separated from the flowers or seeds they were laid on and transferred to a deep Petri dish (1.5 cm) lined with a moistened filter paper and covered with muslin fitted in place by rubber band. They were kept in the laboratory under room temperature of 25 ± 2 °C and 60–65% RH until hatching. Incubation period was recorded. Hatched nymphs were reared in groups in 2-l plastic jars and inspected daily. Molted individuals of the same day were transferred to another plastic cage provided with *Dodonaea* flowers and green seed bunches and so on till reaching the adult stage. Adults were left in groups for copulation. Thereafter, mated females were reared individually in the lady stockings cages provided by *Dodonaea* flowers, green seeds, and branches with young leaves as a source of food and as an ovipositional site. When the egg masses were laid, they were picked out and counted. Adults were kept and fed in the ovipositional cages till death and life span was calculated.

Durations of parasitoid stages

Some parasitized egg masses of *D. silphoides* were collected from the *Dodonaea* plants and transferred to the laboratory. They were placed in 1 × 3 in. glass tubes closed by muslin fixed in place by rubber bands until emerging of the adult parasitoids (El-Husseini et al. 2006). They copulate immediately in the glass tube. Thereafter, each female was introduced to a glass tube provided with a paper strip carrying fine bee honey droplets as food for the parasitoid adults. The tubes were previously provided with freshly laid egg masses of *D. silphoides* and left exposed to parasitism for 24 h. In the second day, the egg masses were replaced with another freshly laid ones and those exposed to the parasitoid were placed in small Petri dishes (5 cm in diameter) furnished with moistened filter paper and inspected daily until emergence of adult parasitoids. The total developmental period of *T. basalis* was recorded as well as number of parasitized eggs to calculate the fecundity and longevity of female and male parasitoid. The study was carried out under room temperature of 25 ± 2 °C and 60–65% RH.

Statistical analysis

Data was subjected to analysis by *F* test. Percentage values were subjected to arcsine square root transformation to increase the homogeneity of variance and normality. Data were analyzed by one-way analysis of variance (ANOVA), and means were compared by least significant difference (LSD).

Results and discussion

Fluctuation of *D. silphoides* and its egg parasitoid, *T. basalis*

Egg masses of *D. silphoides* were always found on the flowers and fruits (green seeds) of the ornamental plant *D. viscosa* and sometimes on the very young apical leaves. The laid egg masses composed mostly of 10 to 15 eggs arranged in three cues; the middle one is the longest (Fig. 1a).

It is easy to differentiate between the eggs that hatched normally giving L1 nymphs of *D. silphoides* and those from which the scelionid wasp had emerged from (Fig. 1a and b). The latter were like those cited wrong on a photo by Novoselsky et al. (2015), where the exit opening on the egg operculum was of a round shape. Meanwhile, by bug hatching, the nymph presses the egg operculum upwards, separating it partially from the transparent egg shell in a circular-like cut as seen in (Fig. 1c) from which it leaves the egg.

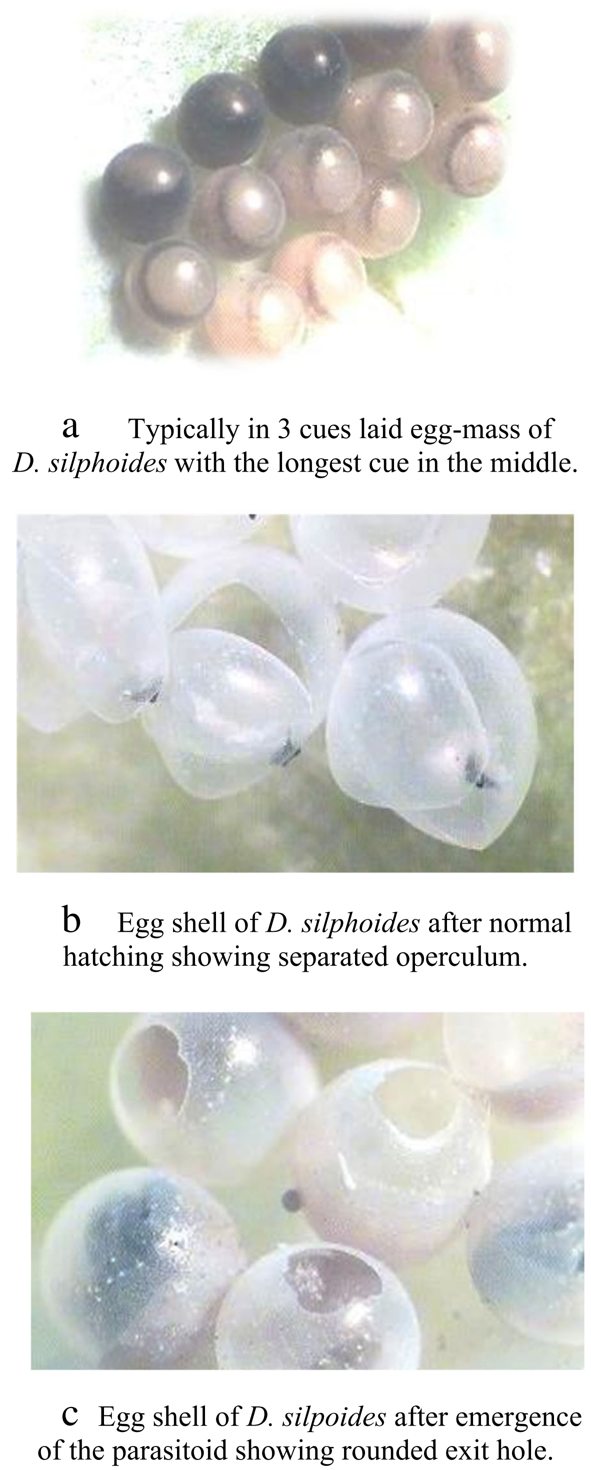

Fig. 1 **a** Typically in 3 cues laid egg mass of *D. silphoides* with the longest in the middle. **b** Egg shell of *D. silphoides* after normal hatching showing separated operculum. **c** Egg shell of *D. silphoides* after emergence of the parasitoid showing rounded exit hole

Numbers of healthy (non-parasitized) and parasitized eggs of *D. silphoides* on *Dodonaea* flowering in seasons of 2016 and 2017 are presented in Table 1. Inspecting egg numbers of the bug 1st generation on 25 flowers or green seed bunches showed the highest (20 and 17 eggs) in the 3rd week of March in both years 2016 and 2017, respectively. Meanwhile, the parasitism rate with *T. basalis* recorded a range between 37.5% among the early laid eggs in the 1st week of March 2016 opposed to 33.3% for the same period in 2017. The highest rate of parasitism reached 68.4% in the 4th week of April 2016 and in the 3rd week of March 2017 (70.5%). Results in Table 1 show two recorded peaks for egg numbers and also two peaks of parasitized eggs during the activity period from early March to end of May for both the bug and the parasitoid. Thus, it could be concluded that *D. silphoides* had two generations per year, peaking in 3rd week of March and 4th week of April. By increasing the summer temperature by the end of May, all the bug individuals were mostly in the 5th nymphal instar and adults enter a summer aestivation under the heavy fallen leaves (litters) of *Dodonaea* until the next year by end of February and beginning of March synchronizing with the flowering time of their host plant, *Dodonaea*. This observation is in line with that of Monteith (1982). In Egypt, *D. silphoides* has not been recorded on any other plants during its activity period from March to May.

Meanwhile, results concerning *T. basalis* cannot impose the conclusion that it had only two generations per year; it may have other generations on eggs of other species of family Pentatomidae in the country, e.g., the green stink bug, *Nezara viridula* L., and the melon leaf black bug, *Aspongopus viduatus* F. (El-Husseini et al. 2006).

Durations of immature stages of *D. silphoides*

Under laboratory conditions, incubation period of the eggs ranged between 4 and 5 days with an average of 4.2 ± 0.7 days. The 5 nymphal instars lived each for 4–5, 3–4, 7–9, 8–9, and 8–11 days with the averages of 4.2 ± 7, 3.2 ± 0.1, 8.3 ± 0.3, 8.5 ± 0.2, and 9.6 ± 0.6 days, respectively.

Table 1 Weekly numbers of healthy and parasitized egg masses of *D. silphoides* on 25 flower or green seed bunches of *Dodonaea* in 2016 and 2017

	March				April				May			
Weeks	1	2	3	4	1	2	3	4	1	2	3	4
2016 (healthy)	8	12	20	0	0	8	12	19	15	2	0	0
2016 (parasitized)	3	5	11	0	0	4	5	13	10	0	0	0
%	37.5	41.6	55	–	–	50	41.6	68.4	66.6	–	–	–
2017 (healthy)	9	10	17	1	0	9	13	20	13	2	0	0
2017 (parasitized)	3	5	12	0	0	2	5	12	5	0	0	0
%	33.3	50	70.5	–	–	22.2	38.4	60	38.4	–	–	–

Table 2 Numbers of *D. silphoides* (nymphs and adults) on 25 flower or green seed bunches of *Dodonaea* in 2016 and 2017

Weeks	March				April				May				June			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2016	60	70	250	350	460	210	110	230	380	430	340	110	68	55	10	3
2017	40	55	220	310	410	180	115	220	400	450	300	70	60	49	8	2

Generations of *D. silphoides*

As shown in Table 2, abundance of nymphs and adults for this new recorded pest in Egypt revealed 2 generations per year. Individuals of the 1st one extended from the 1st week of March peaking between 4th week of March and 1st week of April in both seasons 2016 and 2017. Concerning the 2nd generation, its individuals extended from the 3rd week of April to the 4th week of May peaking in the 1st week of April and the 2nd week of May. Its remaining individuals, mostly adults, aggregated under the dry *Dodonaea* leaves (litters) heavily covering soil under the host plant entering a summer aestivation.

Durations of parasitoid stages and sex ratio

Egg masses of *D. silphoides* exposed to *T. basalis* female parasitoid for 24 h, under laboratory conditions, produced adult parasitoids in 15–16 days with an average of 15.4 ± 0.48 days. These results relatively agree with those of El-Husseini et al. (2006) when *T. basalis* parasitized the eggs of the green stink bug, *Nezara viridula* L.

The mated females produced 48–55 (49.5 ± 2.1) progeny during its life span that ranged between 23 and 26 days (23.5 ± 1.2). Most of the offspring was produced during the 1st week of adult life time. Males lived for 18–21 days, with an average of 19.3 ± 1.0 days and mated with more than one female. Progeny sex ratio ranged from 0.8 to 0.9, nearly 1:1.

Conclusion

The scutellerid shield bug, *D. silphoides*, is a new insect pest species attacking the ornamental plant, *D. viscosa*, in Egypt. Abundance of both the bug and its associated egg parasitoid, *T. basalis*, showed 2 generations in March and April, synchronizing with the flowering time of the host plant *D. viscosa*. Afterwards, *D. silphoides* adults aggregated under the dry *Dodonaea* leaves (litters) heavily covering soil under the host plant entering a summer aestivation. Some biological aspects of the bug and its parasitoid were described.

Acknowledgements
The authors thank Dr. Jürgen Deckert at Museum für Naturkunde in Berlin for identifying the bug as *Deroplax* sp. and highly appreciate the help offered by Ornamental Department, Faculty of Agriculture, at Cairo University, for facilitating the material sampling from its Experimental Station.

Funding
This work was not supported by any funding body, but personally financed.

Availability of data and materials
All data are available at the article, and the materials used in this work are of high transparency and grade.

Authors' contributions
All authors read and approved the final manuscript.

Ethics approval and consent to participate
We agree to all concerned regulations.

Consent for publication
We agree to publish this scientific paper at the EJBPC.

Competing interests
The authors declare that they have no competing interests.

Publisher's Note

Author details
[1]Center of Biological Control, Faculty of Agriculture, Cairo University, Giza, Egypt. [2]Plant Protection Department, Faculty of Agriculture, Damanhour University, Damanhour, Egypt.

Received: 2 November 2018 Accepted: 23 April 2019
Published online: 22 May 2019

References

Ahmad I, Mouizzodin M, Mushtaq S (1988) A revision of the genus *Deroplax* (Hemiptera: Scutelleridae) from Oriental Region with description of two new species from Pakistan and Bangladesh. Orient Insects 22:259–266

Dodd FP (1904) Notes on maternal instinct in Rhynchota. Trans Entomol Soc Lond 3:483–485

El Hawgary MS, Khalil MW, Sharaf MR, Fadi HH, Aldawood AS (2013) A preliminary study on the insect fauna of Al-Baha Province, Saudi Arabia, with descriptions of two new species Zookeys (274):1–88

El-Husseini MM, Draz KAA, El-Aw MA, Askar SI (2006) Some biological and morphological aspects of *Trissolcus basalis* Wollaston (Hymenoptera: Scelionidae) an egg parasitoid of *Nezara viridula* (L) (Heteroptera: Pentatomidae). Egypt J Biol Pest Control 16(2):111–114

Göllner-Scheiding U (2006) Family Scutelleridae Leach, 1815 – shield bugs. In: Aukema B, Rieger C (eds) Catalogue of the Heteroptera of the Palaearctic Region. 5, Pentatomomorpha II. The Netherlands entomological society, Wageningen, pp 190–227

Javahery M, Schafeer CW, Lattin JD (2000) Shield Bugs (Scutelleridae). In: Schaffer CW, Panizzi AR (eds) Heteroptera of economic importance. CRC Press, Boca Raton, pp 475–503

Kirkadly GW (1909) Catalogue of the Hemiptera (Heteroptera) Vol. 1. Cimicidae. Felix Dames, Berlin xl, 1-392

Leston D (1953) Notes on the Ethiopian Pentatmoidea X. Ann S Afr Mus 41:48–60

Monteith GB (1982) Dry season aggregations of insects in Australian monsoon forests. Mem Qld Mus 20(3):533–543

Monteith GB (2006) Maternal care in Australian oncomerine shield bugs (Insecta, Heteroptera, Tessaratomidae). Denisia 19:1135–1152

Novoselsky T, Furth D, EGER JE, Zvik Y (2015) *Deroplax silphoides* (Hemiptera: Heteroptera: Scutelleridae): a new plant pest in Israel. Isr J Entomol 44–45:5–12

Schoutenden H (1904) Heteroptera. Fam. Pentatomidae. Subfam. Scutellerinae, in Wytasman P. (ed), vol 24. Genera Insectorum, Brussels pp 1–98, Pls 1-5.

Scott JK (1990) *Tribulus trerrestris* L. (Zygophyllaceae) in southern Africa: an outline of biology and potential biological control agent for Australia. Plant Prot Q 5(3):103–106

Tallamy DW (1998) Child care among the insects. Sci Am 1999:73–77

Tallamy DW, Schafeer CW (1997) Maternal care in the Hemiptera: ancestry, alternatives, and current adaptive value. In: Chloe JC, Crespi BJ (eds) Social behaviour in insects and arachnids. Cambridge University press, Cambridge xii + 1-541