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Short Communication

Biology and Bionomics of Dusky Cotton Bug (*Oxycarenus laetus*) (Lygaeidae: Hemiptera) on Three Different Hosts

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Authors' Contribution
MS performed the experiments. SMZ supervised the work. SMTAS coordinated the experiments.

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ABSTRACT

The dusky cotton bug, *Oxycarenus laetus* Kirby. (Lygaidae: Hemiptera) had become a critical pest of cotton crop. Dusky cotton bug feeds on leaves, stems and seeds of host plants. Being a serious pest of many important crops, the present work will study on biology and bionomics of *O. laetus* on three different hosts *Gossypium hirsutum, Abelmoschus esculentus* and *Helianthus annuus*. Shorter nymphal duration was observed on *Gossypium hirsutum* 20.00±0.14 days as compared to *Abelmoschus esculentus* 21.00±0.26 days and *Helianthus annuus* 23.80±0.20 days. The longer adult life was observed on *G. hirsutum* (female 13.40±0.76 days and male 12.20±0.22 days) as compared to *A. esculentus* (female 9.40±0.40 days and male 8.20±0.37 days) and *H. annuus* (female 11.40±0.51 days and male 10.20±0.58 days). Fecundity (mean number of eggs) was significantly highestin case of *G. hirsutum* (16.33±0.88)as compared to *A. esculentus* (11.67±0.67) and *H. annuus* (6.67±0.33). Biology and bionomic study on different hosts will help the researchers make IPM strategies.

Cotton is one of the main cash crops which account 5.1 percent in agriculture value addition and 1.0 percent of GDP in Pakistan. It provides raw material for textile industries and cotton lint is also exported. The crop was cultivated on 2917 thousand hectare during the year, 2015-16 (Anonymous, 2015-16). Average per acre yield of cotton is still low after many struggles in Pakistan as compared to other states (Bakhsh *et al*., 2005). Insect pests are the most significant factors that causing 30-40% yield loss of cotton (Kannan *et al*., 2004). In all cotton growing areas dusky cotton bug *Oxycranus laetus* (Hemiptera: Lygaeidae) is the most important pest that cause losses at economic level (Henry, 1983). Seeds of cotton appear undamaged but seed weight reduces up to 15% by internal feeding of *O. laetus*. Seeds are unable to grow and became useless. The damage of *O. laetus* also results in lint staining of cotton and seed quality deteriorate (Khan and Ahmed, 2000). *O. laetus* population also affects stored cotton (Henry, 1983). Severe attack of bugs results in less germination of seeds. It produces unpleasant smell when fed on cotton seeds. (Nakache, 1992; Thangavelu, 2007). *O. laetus* female prefers new bolls during oviposition (Sharma and Pamphapathy, 2006; Samy, 2007). Nymphs and adults of dusky cotton bug fed on stem, seeds and leaves of host plants (Sewify and Semeada, 1993). Feeding of dusky cotton bug was also reported on apple, maize, dates, figs, grapes, peach, okra and pineapple (USDA, 2009). Dusky cotton bug can feed on young petiole tissues (Holtz, 2006). Currently dusky cotton bug has 40 hosts reported from malvales order. These host plants produce seeds for dusky cotton bug at different time intervals of the year (Schaefer and Panizzi, 2000). Focus of our work was to explore the knowledge about comparative biology of *O. laetus* on three different hosts *Gossypium hirsutum, Abelmoschus esculentus* and *Helianthus annuus* and to study comparative change in bionomics on different hosts i.e. body length, width, antennal size, proboscis, pro-leg, meso-leg, meta-leg, fore and hind wing size of *O. laetus*.

Materials and methods

The adults of *O. laetus* were collected from cotton field of Bahauddin Zakariya University, Multan, Punjab, Pakistan on 2 October, 2017. The adults were reared in plastic jar (11×4×4 inches). The mouth of jars were covered with the muslin cloth and tied with the rubber band. Rearing was done under the laboratory condition 27±2°C, 70±5% R.H and photoperiod L14: D10 h. For rearing, cotton seeds (*Gossypium hirsutum*) were obtained from cotton research

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station Multan, while okra seeds (*Abelmoschus esculentus*) and sun flower seeds (*Helianthus annuus*) were obtained from local nursery. Soaked seeds were provided in separate petri dishes for feeding of *O. laetus*. Seeds were changed after every two days. Cotton soaked in water and placed in each jar to maintain the moisture level.

To study the reproductive biology of *O. laetus* on three hosts, fifteen newly hatched nymphs were selected from the collection and placed in petri dishes separately provided (*Gossypium hirsutum*, *Abelmoschus esculentus* and *Helianthus annuus*) seeds and very small cotton soak for moisture. Nymphal duration and adult longevity of both male and female of *O. laetus* were also recorded by observing either with eyes or where necessary with a simple microscope.

For studying bionomics, five replications were made and each replication representing five individuals of each instar which were randomly selected. Length and width of each body parts were measured. Stage micrometer (0.01-1 mm) ocular micrometer (0.2-2.5 mm) and graded scales (1-150 mm) were used for taking the measurement of each body part.

The data were statistically analyzed according to Completely Randomized Design on Statistical Analysis System (SAS Institute, 2002).

Results and discussion

First nymph: Duration of the first nymph was longer on *H. annuus* i.e. 4.40±0.24 days as compared to that of *A. esculentus* 4.00±0.32 days and *G. hirsutum* 3.80±0.22 days (P= 0.284, F= 1.40, df= 2, 14) (Fig. 1). The length of meso-leg was significantly greater on *G. hirsutum* 0.84±0.02 mm than that of *H. annuus* 0.76±0.04 mm and *A. esculentus* 0.74±0.02 mm (P= 0.041, F= 3.00, df= 2). Proboscis length 1.22±0.04 mm, antennal length 0.80±0.03 mm, length of pro-leg 0.62±0.04 mm, length of meta-leg 1.02±0.02 mm, body length 1.08±0.04 mm and body width 0.24±0.02 mm were found to be highest on *G. hirsutum* than other two hosts i.e. *A. esculentus* and *H. annuus* (Table I).

Second nymph: Duration of second nymph was longer on *H. annuus* i.e. 5.20±0.37 days as compared to *A. esculentus* 4.40±0.40 days and *G. hirsutum* 4.40±0.27 days (P= 0.210, F= 1.78, df= 2, 14) (Fig. 1). The body length of 2nd nymph was significantly greater on *G. hirsutum* 1.48±0.02 mm as compared to *H. annuus* 1.34±0.02 mm and *A. esculentus* 1.24±0.04 mm (P<0.0001, F= 16.67, df= 2). Measured length of proboscis 1.16±0.04 mm, length of antennae 0.94±0.02 mm, length of pro-leg 0.76±0.02 mm, length of meso-leg 0.96±0.02 mm, length of meta-leg 1.18±0.02 mm, and body width 0.38±0.02 mm were highest on *G. hirsutum* than other two hosts i.e. *A. esculentus* and *H. annuus* (Table I).

Third nymph: Duration of third nymph was longer on *A. esculentus* 5.00±0.45 days than other two hosts i.e. *G. hirsutum* and *H. annuus* (P= 0.291, F= 1.37. df= 2, 14) (Fig. 1). The size of pro-leg was same on *G. hirsutum* and *A. esculentus* 1.02±0.04 mm respectively and greater than *H. annuus* 0.94±0.04 mm. The length of meso-leg was significantly highest on *G. hirsutum* 1.24±0.02 mm as compared to *H. annuus* 1.16±0.02 mm and *A. esculentus* 1.14±0.02 mm (P= 0.031, F= 4.67, df= 2). Proboscis length 1.60±0.04 mm, antennal length 1.10±0.03 mm, length of meta-leg 1.46±0.02 mm, length of body 1.86±0.04 mm and length of width 0.78±0.04 were highest on *G. hirsutum* then *A. esculentus* and *H. annuus* (Table I).

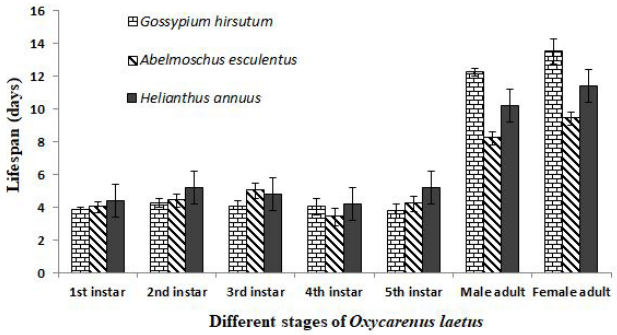

Fig. 1. Life duration of each stage of *Oxycarenus laetus* on different hosts.

Fourth nymph: Highest duration of fourth nymph 4.20±0.20 days was found on *H. annuus* than *G. hirsutum* 4.00±0.50 days and *A. esculentus* 3.40±0.51 days (P= 0.383, F= 1.04, df= 2, 14) (Fig. 1). Measured proboscis length 1.88±0.04 mm, antennal length 1.54±0.04 mm, length of pro-leg 1.36±0.02 mm, length of meso-leg 1.60±03 mm, length of meta-leg 1.94±0.05 mm and length of body 2.96±0.05 were greater on *G. hirsutum* than that of *A. esculentus* and *H. annuus*. The body width 1.16±0.02 mm was significantly higher on *G. hirsutum* than *H. annuus* and *A. esculentus* (P= 0.019, F= 5.56, df= 2) (Table I).

Fifth nymph: Duration of fifth nymph was significantly highest on *H. annuus* 5.20±0.20 days as compared to *G. hirsutum* 3.60±0.45 days and *A. esculentus* 4.20±0.49 days (P= 0.035, F= 4.45, df= 2, 14) (Fig. 1). The length of antennae 1.84±0.02 mm, length of meta-leg 2.32±0.04 mm, body length 3.58±0.04 mm and body width were significantly highest on *G. hirsutum*. Proboscis length 2.48±0.05 mm, length of pro-leg 1.56±0.02 mm and length of meso-leg 1.88±0.04 mm were found to be highest on *G. hirsutum* as compared to *A. esculentus* and *H. annuus* (Table I).

Table I. Bionomics of *Oxycarenus laetus* in relation to different stages.

Insect stages	Seeds	Size of different body parts (mm ± S.E)								
		Proboscis	Antennae	Pro-leg	Meso-leg	Meta-leg	Body length	Body width	Fore wing	Hind wing
1st instar	*G. hirsutum*	1.22±0.04a	0.80±0.03a	0.62±0.04a	0.84±0.02a	1.02±0.02a	1.08±0.04a	0.24±0.02a		
	A. esculentus	1.08±0.04a	0.78±0.04a	0.60±0.03a	0.74±0.02b	0.98±0.02a	1.02±0.02a	0.22±0.02a		
	H. annuus	1.12±0.04a	0.70±0.03a	0.54±0.05a	0.76±0.04ab	0.96±0.04a	1.04±0.02a	0.18±0.04a		
2nd instar	*G. hirsutum*	1.16±0.04a	0.94±0.02a	0.76±0.02a	0.96±0.02a	1.18±0.02a	1.48±0.02a	0.38±0.02a		
	A. esculentus	1.10±0.04a	0.92±0.04a	0.68±0.04a	0.90±0.03a	1.10±0.03a	1.24±0.04c	0.30±0.03b		
	H. annuus	1.10±0.04a	0.90±0.03a	0.70±0.05a	0.88±0.04a	1.10±0.03a	1.34±0.02b	0.34±0.02ab		
3rd instar	*G. hirsutum*	1.60±0.04a	1.10±0.03a	1.02±0.04a	1.24±0.02a	1.46±0.02a	1.86±0.04a	0.78±0.04a		
	A. esculentus	1.56±0.02a	1.04±0.02a	1.02±0.04a	1.14±0.02b	1.36±0.04a	1.84±0.02a	0.72±0.04a		
	H. annuus	1.52±0.04a	1.02±0.04a	0.94±0.04a	1.16±0.02b	1.38±0.04a	1.76±0.06a	0.74±0.02a		
4th instar	*G. hirsutum*	1.88±0.04a	1.54±0.04a	1.36±0.02a	1.60±0.03a	1.94±0.05a	2.96±0.05a	1.16±0.02a		
	A. esculentus	1.86±0.02a	1.42±0.04a	1.30±0.03a	1.58±0.04a	1.86±0.02a	2.66±0.05b	1.06±0.02b		
	H. annuus	1.84±0.04a	1.46±0.05a	1.30±0.03a	1.52±0.04a	1.86±0.05a	2.86±0.05a	1.06±0.02b		
5th instar	*G. hirsutum*	2.48±0.05a	1.84±0.02a	1.56±0.02a	1.88±0.04a	2.32±0.04a	3.58±0.04a	1.46±0.02a		
	A. esculentus	2.34±0.04a	1.76±0.02b	1.50±0.03a	1.78±0.02a	2.08±0.04b	3.06±0.05b	1.28±0.02b		
	H. annuus	2.40±0.05a	1.74±0.02b	1.50±0.03a	1.78±0.04a	2.30±0.03a	3.52±0.04a	1.38±0.04a		
Male adult	*G. hirsutum*	2.60±0.03a	2.16±0.04a	2.00±0.04a	2.24±0.05a	2.82±0.04a	4.38±0.04a	1.38±0.04a	2.98±0.04a	2.46±0.05a
	A. esculentus	2.50±0.04a	2.10±0.03a	1.88±0.02b	2.16±0.02ab	2.56±0.02b	3.92±0.04c	1.28±0.02a	2.82±0.04b	2.44±0.02a
	H. annuus	2.52±0.04a	2.08±0.04a	1.86±0.04b	2.10±0.04b	2.54±0.02b	4.08±0.04b	1.28±0.04a	2.96±0.02a	2.42±0.04a
Female adult	*G. hirsutum*	2.78±0.04a	2.36±0.04a	2.16±0.04a	2.48±0.04a	3.06±0.02a	4.68±0.04a	1.60±0.03a	3.10±0.03a	2.56±0.04a
	A. esculentus	2.72±0.02ab	2.34±0.02a	2.10±0.03a	2.42±0.04ab	2.96±0.02b	4.52±0.04b	1.52±0.04a	3.04±0.02a	2.42±0.04b
	H. annuus	2.66±0.02b	2.28±0.04a	2.08±0.04a	2.32±0.04b	3.06±0.04a	4.48±0.04b	1.52±0.02a	3.04±0.02a	2.52±0.02ab

Means followed by the same latters along the column are statistically non-significant (P<0.05). Analysis of all the stages was done separately.

Adult male: Significant highest duration of adult male 12.20±0.22 days was found on *G. hirsutum* than that of *H. annuus* 10.20±0.58 days and *A. esculentus* 8.20±0.37 days (P< 0.0001, F= 23.08, df= 2, 14) (Fig. 1). The length of pro-leg 2.00±0.04 mm, length of meso-leg 2.24±0.05 mm, length of meta-leg 2.82±0.04 mm, body length 4.38±0.04 mm and length of fore-wing 2.98±0.04 mm were significantly highest on *G. hirsutum* than *A. esculentus* and *H. annuus*. Measured proboscis length 2.60±0.03 mm, antennal length 2.16±0.04 mm, body width 1.38±0.04 mm and length of hind-wing 2.46±0.05 mm were higher on *G. hirsutum* as compared to *A. esculentus* and *H. annuus* (Table I).

Adult female: Duration of adult female 13.40±0.76 days was significantly higher on *G. hirsutum* as compared to *H. annuus* 11.40±.51 days and *A. esculentus* 9.40±0.40 days (P< 0.0001, F= 13.64, df=2, 14) (Fig. 1). The length of proboscis 2.78±0.04 mm, length of meso-leg 2.48±0.04 mm, length of meta-leg 3.06±0.02 mm, body length 4.68±0.04 mm and length of hind-wing 2.56±0.04 mm were significantly highest on *G. hirsutum* as compared to *A. esculentus* and *H. annuus*. Length of antennae 2.36±0.04 mm, length of pro-leg 2.16±0.04 mm, body width 1.60±0.03 mm and length of fore-wing 3.10±0.03 mm were greater than *A. esculentus* and *H. annuus* (Table I). The body length, width, antenna size, proboscis, foreleg, hind leg, fore-wing and hind-wing explain the vigor of insects on the hosts (Bilgrami and Gaugler, 2004). No previous studies have been found on the bionomics of *O. laetus*. In our study, we measured the body parts of both immature and mature stages of *O. laetus*. *D. koenigii* was reared on seeds of *G. hirsutum* and *A. esculentus* to keep up uniformity (Kohno and Ngan, 2004). Duration of nymphs was minimum on *G. hirsutum*. While, fecundity was maximum on *G. hirsutum* (Saxena, 1969).

Fecundity: Fecundity of *O. laetus* was significantly highest, when fed on *G. hirsutum* 16.33±0.88 eggs as compared to *A. esculentus* 11.67±0.67 eggs and *H. annuus* 6.67±0.33 eggs (P<0.0002, F= 52.58, df= 2) (Fig. 2). The highest survival and reproductive rate

of insects have variation when fed on different hosts (Kumar and Sahu, 2009).

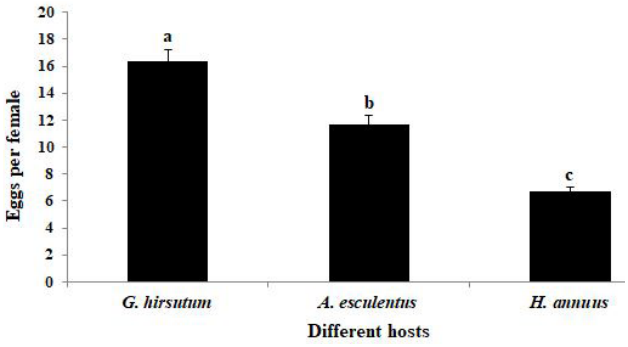

Fig. 2. Number of eggs laid by *Oxycarenus laetus* on different hosts.

Conclusion

The study concludes that *G. hirsutum* is the most preferable host for survival, longevity and fecundity of *O. laetus* as compared to *A. esculentus* and *H. annuus*. *A. esculentus* and *H. annuus* do not grow in *G. hirsutum* growing areas but *O. laetus* can successfully complete their life cycle on these hosts. This study provides the frame work for future detailed study on the immature and mature stages of *O. laetus*.

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Statement of conflict of interest

The authors declare there is no conflict of interest.

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