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Comparative Growth Rate, Fecundity and Behavioural Diversity of the Dusky Cotton Bug, *Oxycarenus hyalinipennis* Costa (Hemiptera : Lygaeidae) on certain Malvaceous Host Plants

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Studies on the comparative efficiency of some common species of malvaceous host plants in relation to the growth and fecundity of *Oxycarenus hyalinipennis* Costa indicated the following sequence, *Gossypium hirsutum*> *Abutilon indicum*> *A. crispum*> *Sida rhombifolia*> *S. rhomboidea*. The ability of *O. hyalinipennis* in successfully colonizing on different malvaceous host plants is discussed on the basis of the nutritional differences among the host plants, in particular reference to carbohydrates, proteins and nitrogen content of the seeds. A model for the differential feeding behaviour of *O. hyalinipennis* on its main and feral host plants, is also given.

Key Words: Growth rate, Fecundity, Behavioural diversity, Dusky cotton bug, *Oxycarenus hyalinipennis*, Malvaceous host plants

Introduction

The tendency of several lygaeid species to become oligophagous is well illustrated by the comparatively wide host range demonstrated by any species (Pearson 1958). The fecundity of the species varies with the specific food plant and it involves both physical and chemical parameters (Fraenkel 1959, Thorsteinson 1960, Slansky & Feeny 1977). Phytophagous lygaeids attack the vegetative parts of the plant and several others feed on the fruits and seeds (Sweet 1960, Eyles 1964).

Frings et al. (1957) showed that the substituted food reduced the fecundity in *Oncopeltus fasciatus* (Dallas). Johansson (1958) reported that the quantity and quality of food influences the pre-oviposition period and fecundity in *O. fasciatus*, whereas Beck et al. (1956) demonstrated that although synthetic food supports normal growth of this species, it causes nearly 33% mortality close to the final moult. Eyles (1964) reported that diet alone influences growth rate in a few rhyparochrominae species.

Species of the genus *Oxycarenus* Fieber

are particularly associated with the ripe seeds of cotton and other malvaceous plants. Both adults and nymphs suck oil from mature seeds and sap from leaves and young stems to obtain moisture (Odhiambo 1957). The dusky cotton bug, *Oxycarenus hyalinipennis* (Costa) a minor pest of cotton throughout India—feeds on the seeds of several malvaceous plants (Thangavelu 1978) including malvaceous weed plants during off-seasons. An attempt has been made here to study the feeding preferences in terms of fecundity and growth rate of *Oxycarenus hyalinipennis* on some common malvaceous weeds.

Material and Methods

Adults of *O. hyalinipennis* collected from various host plants such as cotton (*Gossypium hirsutum*), *Abutilon indicum*, *A. crispum*, *Sida rhombifolia*, and *S. rhomboidea* were reared in laboratory on the seeds of their respective host plants. Moisture requirements were met by providing a cotton wad soaked in water. Fresh seeds were provided once in three days. For egg-laying, non-absorbent cotton buds were provided inside the rearing cages.

(a) *Growth Studies*

To study the growth rate of *O. hyalinipennis* on different malvaceous host plants, freshly-hatched first instar nymphs and subsequent nymphal stages were fed on the seeds of the respective host plants. Since the difference in weight between instars is considerably low, their body lengths were taken for an assessment of the comparative growth rate on different host plants. Care was taken that insects did not show inter-segmental stretching at the time of measurement. Besides, the ability of the 5th instar nymphs to moult and metamorphose on the test plant, and the average period required for transformation were also noted. This represents the 'growth index' (Saxena 1969).

(b) *Fecundity Studies*

For studying the fecundity of *O. hyalinipennis* on different malvaceous host plants, freshly-hatched adult male and female pairs which were formerly reared on the respective host-plant seeds were confined in plastic vials. Immature capsules of the respective host plants were provided for oviposition. Fecundity was assessed on the basis of the pre-oviposition period and the number of eggs laid during the life time. The ratio between these was taken as the overall 'fecundity index' of the insect (Saxena 1969).

(c) *Biochemical Studies*

The total carbohydrates (reducing and non-reducing) were estimated by colorimetric method (Carrols et al. 1956) using Anthrone reagent. Total nitrogen content was estimated by the volumetric method of Vogel (1963), whereas the total proteins were calculated according to the Lowry et al. (1951) using Spectronic 21.

Observations and Results

It is evident from table 1 that the development rate was faster on *G. hirsutum* (21 days) followed by *A. indicum* (22.4 days), *A. crispum & S. rhombifolia* (23.6 days), and *S. rhomboidea* (24.2 days). The comparative growth rate with respect to the total body length was also higher for individuals reared on cotton seeds (figure 1). Interestingly enough, the increase in growth rate was significant from the 3rd instar onwards. The 'growth index' was also higher for *G. hirsutum* (19.74), followed by *A. indicum* (19.23) *A. crispum* (18.20), *S. rhombifolia* (16.30) and *S. rhomboidea* (14.85), (table 2).

The females of *O. hyalinipennis*,

Table 1 *Development of* O. hyalinipennis *on different malvaceous host plants*†

Sl. No.	Host plants	Incubation period	Nymphal duration (days)					Total
			1	2	3	4	5	
1.	*Gossypium hirsutum*	3.8±0.33 (3-5)*	2.4±0.24 (2-4)	3.2±0.43 (2-4)	3.4±0.29 (3-5)	3.0±0.18 (3-4)	5.2±0.00 (5.6)	21.0±0.88 (18-28)
2.	*Abutilon indicum*	3.8±0.33 (3-5)	2.8±0.18 (2-3)	3.0±0.39 (2-4)	4.6±0.35 (4-6)	3.0±0.00 (3-0)	5.2±0.24 (4-6)	22.4±1.12 (18-22)
3.	*Abutilon crispum*	3.8±0.18 (3-4)	3.0±0.28 (2-4)	3.6±0.36 (3-5)	4.6±0.35 (4-6)	3.2±0.24 (3-4)	5.4±0.32 (5-6)	23.6±1.31 (20-29)
4.	*Sida rhombifolia*	3.8±0.33 (3-4)	3.2±0.24 (2-4)	3.4±0.22 (3-4)	4.6±0.35 (4-6)	3.2±0.24 (3-4)	5.4±0.32 (5-6)	23.6±1.25 (21-29)
5.	*Sida rhomboidea*	3.8±0.33 (3-5)	3.4±0.29 (3-5)	3.6±0.36 (3-5)	4.6±0.35 (4-6)	3.4±0.29 (3-5)	5.4±0.32 (5-6)	24.2±1.69 (21-32)

†Mean of 5 replications.
*Values represented in parentheses indicate the range.

generally preferred immature capsules/ bolls for oviposition the eggs being normally thrust in the region between the calyx and the fruit wall.

The fecundity rates of *O. hyalinipennis* reveal significant differences in the number of eggs laid on various host plants (table 2). The mean fecundity rate and the fecundity index were the highest (25.17) for cotton seeds and the lowest for *S. rhomboidea*,

An integrated view of the different steps involved in the selection of the host plants by *O. hyalinipennis* is represented

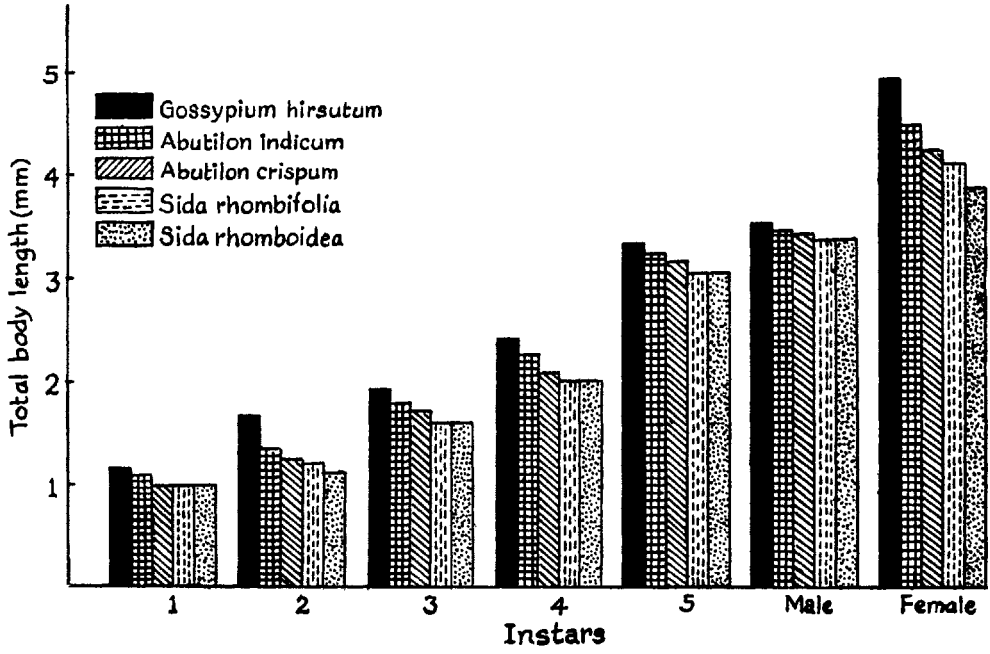

Figure 1 Comparative growth rate of *O. hyalinipennis* on certain malvaceous host plants

Table 2 *Fecundity and growth indices of* Oxycarenus hyalinipennis *on different malvaceous host plants*

Sl. No.	Host plants	Fecundity† index	Growth† index	Mean no. of* eggs laid
1.	*Gossypium hirsutum*	10.45	19.74	25.17
2.	*Abutilon indicum*	5.37	19.23	14.67
3.	*Abutilon crispum*	4.35	18.20	14.17
4.	*Sida rhombifolia*	2.90	16.30	9.67
5.	*Sida rhomboidea*	2.23	14.85	7.00

† Mean of 5 replications, * Significant at 1% level; Critical difference=3.10

A MODEL FOR THE FEEDING OF Oxycarenus hyalinipennis
WITH RESPECT TO CERTAIN MALVACEOUS HOST PLANTS

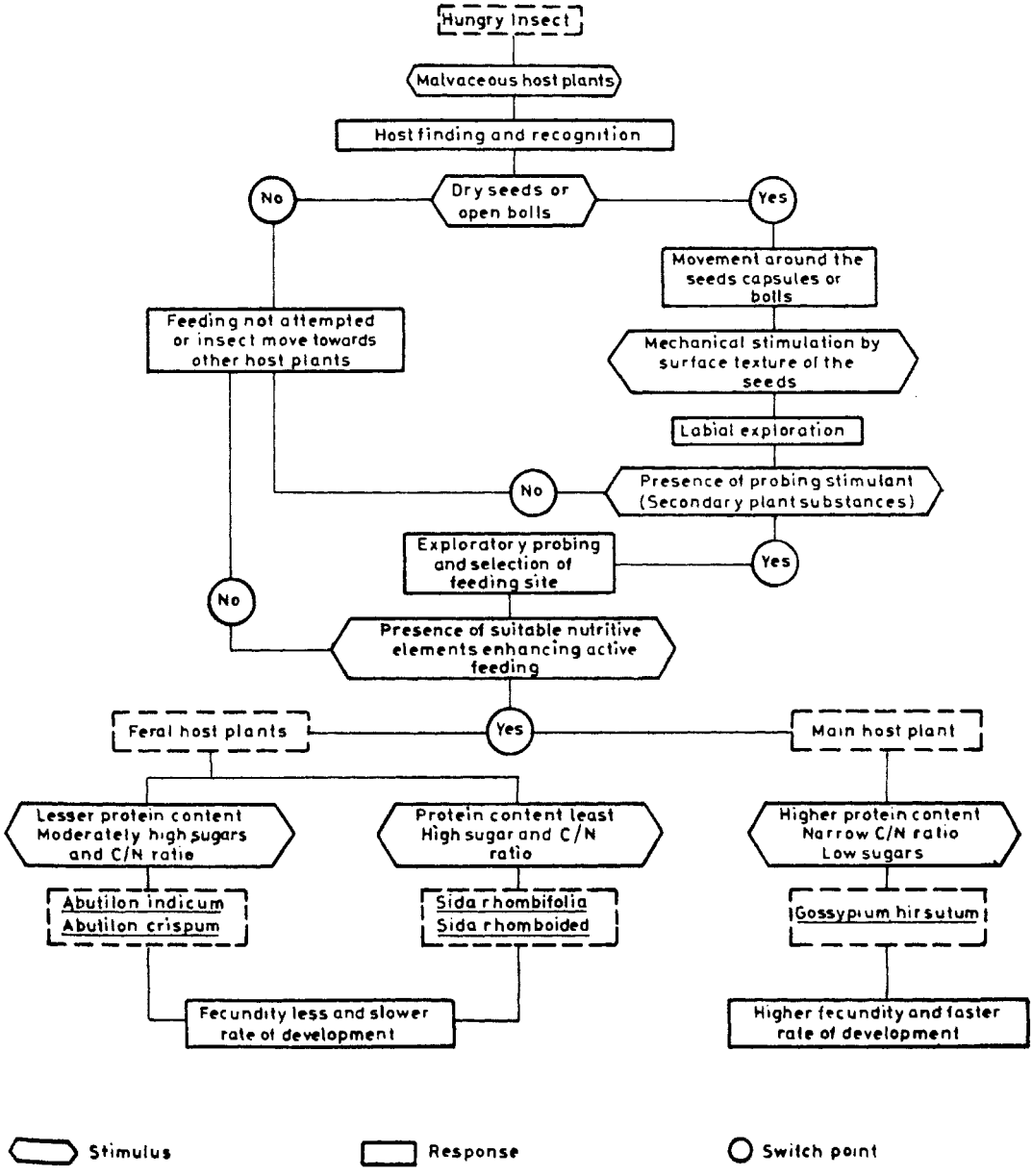

Figure 2

in figure 2. Adults and nymphs feed on the capsules containing mature and dried seeds and less frequently on the calyces and foliage. Host finding and recognition appear to be facilitated by sight and sensillae at the apex of the rostrum during probing. The surface texture of the seeds also provide some sort of mechanical stimulation for the bugs. Under laboratory conditions, rapid movements around the seed capsule are evident prior to feeding. Labial exploration follows probing, the bugs having a tendency to remain without attempting to feed or move towards other host plants in the absence of suitable probing stimulants. Exploratory probing finally ends in the selection of a suitable feeding site. Once the feeding site is selected, the rostrum is firmly planted on the seed coat and the stylets are thrust deeper into the seeds to initiate active feeding.

Discussion

The main feral host plants of the genus *Oxycarenus* are limited to the order Malvales which include the families Malvaceae, Sterculiaceae and Bombaceae (Leston 1970). It has been reported that in Ghana, *Oxycarenus* sp. occurred on *Gossypium* sp., *A. mauritianum, A guineense, S. rhombifolia, S. acuta and S. cordifolia* (Adu-Mensah & Kumar 1977). In India, apart from cotton, *A. indicum, S. acuta, Thespesia populnea, Hibiscus sabdariffa, H. vitifolius* and *H. esculentus* have been listed as host plants of *O. hyalinipennis* (Thangavelu 1978). In the present study *A. crispum* and *S. rhombifolia* have been added to the catalogue of host plants of *O. hyalinipennis* from India.

Optimum feeding and metabolism of ingested food would result in optimum growth of an insect in the immature stage. Saxena (1969) has reported that the development rate and fecundity of *Dysdercus koenigii* was highest on cotton followed by okra and peanut seeds. In the present study, growth rate and fecundity were highest when *O. hyalinipennis* was reared on cotton seeds, followed by *A. indicum, A. crispum, S. rhombifolia* and *S. rhomboidea*. Variation in nymphal growth upto 3rd instar is not significant, but subsequently significant increase in body size was observed. This clearly shows that the critical stage of growth occurred from 3rd instar onwards. Similar trends were reported by Eyles (1964) in a few rhyparochromine species and Thangavelu (1978) in *O. hyalinipennis*. Among the malvaceous host plants tested, the order of preference was *G. hirsutum* > *A. indicum* > *A. crispum* > *S. rhombifolia* > *S. rhomboidea*.

There exists a relationship between the food preference of *O. hyalinipennis* and the nutritional contents of the host plant seeds. It is evident from table 3 that the carbohydrate content is the least in *G. hirsutum* (12 mg/g dry wt) as compared to other host plant seeds, presumably contributing to a faster development rate (figure 1) of *O. hyalinipennis*. Hibbs et al. (1964) in *Empoasca fabae* on potato and Jayaraj and Seshadri (1967) on *E. flavescens* on castor have shown that lower sugar concentration stimulates feeding. Similarly Maltais and Auclair (1957) reported that pea varieties containing higher concentrations of sugar were not preferred by the aphid, *Acyrthosiphon pisum*.

We find that the total nitrogen content (8.73 percent) in cotton seed which was also the most preferred host of *O. hyalinipennis*. The importance of organic nitrogen in the population dynamics of phytophagous insects is very well established (McNeil & Southwood

1978). Increased nitrogen content increases the fecundity, longevity and survival of aphids (van Emden 1973).

A lower sugar/nitrogen ratio is associated with a greater susceptibility of the host plant (Jayaraj 1967, Jayaraj & Seshadri 1967). Among the host plants studied C/N ratio is least for cotton (1.37) followed by *A. indicum* (3.89), *A. crispum* (4.05), *S. rhombifolia* (6.05) and *S. rhomboidea* (9.44) respectively (table 3), while protein content (236.80 mg/g dry wt) is the highest in cotton and the lowest (33.6 mg/g dry wt) in *S. rhomboidea*. Beck (1956) reported that the larvae of *Ostrinia nubilalis* preferred the leaves with low sugar and higher protein contents. This is in agreement with the present results.

In much the same way that seeds differ in their constituents, insects nutritional requirements also differ. This is presumed to be the basis of the differences in food preferences reported above, and the reason for host plant selection could be gustatory (Eyles 1964). Saxena (1969) on *D. koenigii* has shown that the orientational responses of individuals to different food materials differed according to its physiological state. The insects, when adequately desiccated showed a positive orientational response to succulent plant parts. But, in a water-satiated condition the insects would migrate only to certain plants possessing specific attractants in their leaves and seeds. We have observed that nutritive elements of the seeds play a vital role in the feeding preference of *O. hyalinipennis* for different malvaceous host plant seeds. In a more preferred host like cotton, higher fecundity and faster rate of developments were noticed (table 2), presumably due to the high protein and nitrogen content, low sugars and a narrow C/N ratio of cotton seeds. In the absence of its main host plant, the bugs tend to migrate to other malvaceous feral host plants. Chemical composition of these weed plants revealed the presence of lower amount of protein and nitrogen, moderate to high amount of sugars and a high C/N ratio. In accordance with this, lesser fecundity and a slower rate of development were recorded when *O. hyalinipennis* was reared on the seeds of these weed plants (table 1). Thorsteinson (1960) has reported that insects possess unsuspected powers of discrimination resulting from very sensitive chemoreceptors which would enable precise selection between seeds having the same constituents but in different concentrations. However, the fact that *O. hyalinipennis*

Table 3 *Chemical composition of certain malvaceous plant seeds*

Sl. No.	Host plant seed	Carbohydrates (mg/g dry wt)	Nitrogen (%)	C/N ratio	Protein (mg/g dry wt)
1.	*Gossypium hirsutum*	12.00±0.59	8.73±2.63	1.37±0.30	236.80±0.13
2.	*Abutilon indicum*	19.20±0.82	4.94±0.56	3.89±0.33	52.80±0.73
3.	*Abutilon crispum*	19.20±0.82	4.73±0.26	4.05±0.48	60.00±0.89
4.	*Sida rhombifolia*	26.40±3.32	4.36±0.03	6.05±0.70	49.80±1.41
5.	*Sida rhomboidea*	28.80±1.08	3.05±0.47	9.44±0.24	33.60±0.33
	CD at 5%	2.01	0.73	1.40	2.39

survives and develops well on the seeds of malvaceous weed plants indicates the role played by these weed plants by acting as reservoirs during the off seasons.

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