FEEDING AND REPRODUCTIVE BEHAVIOUR OF FLOWER BEETLE, *Mylabris pustulata* THUNB (COLEOPTERA: MELOIDAE)

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ABSTRACT

Flower parts diversity and subsequent impact of the "nutritive value" of *Hibiscus rosasinensis* flower determines the reproductive performance and flower-use pattern of the meloid beetle, *Mylabris pustulata*. Significant differences were observed in the feeding, food utilisation pattern and the reproductive success of the beetle as well as in their nutritive value particularly protein, carbohydrate, lipid, nitrogen, water and sugar in the petals, androecium and gynoecium.

Improved longevity, higher fecundity and shorter oviposition period were observed on the whole flower (petals, androecium, and gynoecium) than with petals + androecium, petals + gynoecium combinations as well as individually on Androecium, Gynoecium and petals. A possible interaction of feeding and reproduction of *M. pustulata* in relation to biochemical diversity of flower parts of *H.rosasinensis* are discussed.

INTRODUCTION

All phytophagous insects are faced with variability in the nutritional quality of their food (Murugan and Ancy George, 1992). Such variety provides the possibility that an insect can achieve a nutritionally appropriate diet by selecting from the 'Cafeteria' available to it (Simpson and Simpson, 1990). This could be accomplished by selecting the food which is closest to being nutritionally optimal or if no such single food is available, by selecting a mixture (Waldbauer and Friedman, 1988).

To demonstrate whether an insect is actively regulating its nutrient intake by selective feeding requires evidence. First, that the balance and quantity of nutrients eaten meets the current demands of the insect better than that provided by eating the same sources of nutrients randomly or in any other combination (Murugan and Senthil Kumar, 1996) and second that selection behaviour is directly modulated by the insect's nutritional state (Simpson and Simpson, 1990) and nutritional indices such as relative growth rate, relative consumption rate and efficiency of conversion of ingested food can be instrumental in helping to determine where and why insects feed.

Quantitative nutrition studies have been performed to determine the adequacy of an insect's food (Jayabalan and Murugan, 1996) and to study the effects of allelochemics on insects (Babu *et al.*, 1996). Nutritional indices of *M. pustulata* feeding on *H. rosasinensis* flower parts have not been established. These would be helpful in determining the importance of the different parts of the flower in the growth of the beetle.

The objectives of this paper were: (i) To determine the flower parts utilisation of beetle in relation to nutrient contents: (ii) to compare the nutritional indices and fecundity of *M. pustulata* on individual flower parts of *H. rosasinensis* as well as in combinations.

MATERIALS AND METHODS

Adults of both sexes of *M. pustulata* collected from *H. rosasinensis* were reared in the laboratory in plastic containers 28 +/- Temp and 75% RH (Relative Humidity). Moisture requirements were met by placing a wet cotton at the end of pedicel of the flower. Fresh flowers and its parts were provided every day for all the experiments.

Consumption, growth rates and food utilisation efficiencies (all based on dry weight) were calculated by gravimetric method (Waldbauer, 1968). Fecundity was assessed by counting the number of eggs laid during the life span.

Total protein, carbohydrates, lipids and nitrogen were analyzed in different parts of flower by methods of Lowry *et al.* (1951), Du Bois *et al.* (1956). Folch *et al.* (1957) and Vogel (1963), respectively. The data were statistically analysed by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

Flower parts influence on the fecundity of *M. pustulata*

Table 1 provides the comparative fecundity of *M. pustulata* fed on different flower parts of *H. rosasinensis*. The fecundity of *M. pustulata* and the total number of eggs laid in each oviposition showed marked variations. The maximum fecundity was observed on whole flower than individual flower parts. Among the combinations, the petals androecium fed beetles showed higher fecundity. Comparatively higher fecundity was recorded on petals fed beetles than androecium and gynoecium.

Quantitative food utilisation

The amount of food ingested by *M. pustulata* varied in different parts of the flower. Among the different floral parts that was tested, the maximum amount of food ingested was on whole flower than the other combinations and individual floral parts. The food ingested was least on gynoecium. The order of preference being whole flower petals + androecium, petals + gynoecium, petals, androecium and gynoecium (Table 2).

The various growth parameters computed CI, RGR, ECI and ECD (CI - Cosumption Index; RGR Relative Growth Rate; ECI - Efficiency of Conservation of Ingested food; ECD Efficiency of Conservation Of Digested food) were also in accordance to food preference, but with some exceptions. The CI and RGR were relatively higher in the case of whole flower and petals + androecium combination than the other flower parts. ECI and ECD were maximum on the whole flower than the combinations and other parts of the flower (Table 2).

Biochemical composition of flower

The various biochemical, nutritional components such as total proteins, total carbohydrates, total lipids, total nitrogen and water were higher in the petals than androecium and gynoecium (Table 3).

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DISCUSSION

Herbivorous insects do not live in a nutritionally homogeneous environment. Their food is variable in both quantity and quality of nutrients it contains (Murugan and Senthil Kumar, 1996). Like vertebrates, insects are able to compensate for such variability by altering their feeding behaviour. They can do this in two ways - by altering the amount of food eaten and by selecting between available foods (Scriber and Feeny, 1979).

Dietary selection involves behavioural decisions both before and after a food is contacted. Some of these decisions involve associatively or non-associatively learned responses, while others are based on innate preferences or direct physiological feedbacks (Baker *et al.*, 1987). Moreover, nutritional requirements vary throughout the life span of an insect with, for instance, the demands of growth and development, reproduction, diapause and migration. In the present study, *M. pustulata* prefer to feed whole flower than the other individual floral parts.

To discuss about the food consumption of pest species, we have to consider the parameters like the rate of feeding, its effect on growth and development and the amount of food digested and converted into body mass. For an accurate estimation of these parameters, the data relating to the rate of food ingested during the experimental period and weight of faecal matter produced in the same period in corresponding weight gain by insects have to be recorded (Jayabalan *et al.*, 1996). These measurements permit comparison of utilisation of different food materials. Since, efficiency of conversion of digested food reflects the allocation of assimilated food to growth, energy metabolism has been interpreted as an indication of higher metabolic maintenance cost for beetle on a lower water diet (Murugan *et al.*, 1992). But in the present study beetle fed on whole flower and petals + androecium combination showed higher growth rate, consumption and increased efficiencies.

The relative growth rates of herbivores are strongly correlated with the nutritional quality of foliage usually expressed as water and nitrogen content (Jayabalan and Murugan, 1996). Low foliar water content is one of the major characteristics of the foliage contributing to its low nutritional quality (Mattson and Scriber, 1987). In our study, the petals posses comparatively higher amount of nitrogen and water, than androecium and gynoecium.

Lipids serve as major dietary source for insects (Turunen and Chippendale, 1989). The petals and androecium of *H. rosasinensis* had comparatively a higher content of lipid than gynoecium. The presence of higher content of lipid in the petals and androecium may be the reason for the increased oviposition period as well as higher fecundity.

Insects require appreciable amount of protein, carbohydrate, lipid and nitrogen (Dadd, 1988). Petals and androecium of *H. rosasinensis* had optimum protein, carbohydrate and lipid content. So, *M. pustulata*, by consuming the whole flower and petals + androecium obtained required amount of nutrients from them, than individual flower parts, and the beetle had beneficial growth and reproduction.

Insects reared on different leaf stages exhibit differences in assimilation efficiency which is directly related to the chemistry of plant as well as water content (Murugan and Ancy George, 1992). In beetles reared on whole flower, the ECI and ECD were found to be increased. This may be due to the balanced nutritional components on whole flower of *H. rosasinensis*. This sort of information on flower and insect's association could be helpful in conservation studies of insects.

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Table 1. Reproductive period and fecundity of M. pustulata *on different parts of* H. rosasinensis *flower.*

Parameters Oviposition period in days	**Whole flower**	**Petals + androecium**	**Petals + gynoecium**	**Petals**	**Androecium**	**Gynoecium**
Oviposition	81.7^{d}	90.6^{c}	96.1^{b}	100.5^{ab}	104.04^{a}	61.7^{e}
Eggs laid I Oviposition	114.8^{a}	104.6^{b}	98.0^{c}	95.2^{c}	90.6^{d}	82.9^{e}
II Oviposition	93.0^{a}	83.0^{b}	76.0^{c}	73.0^{c}	68.9^{d}	64.9^{e}
III Oviposition	76.0^{a}	45.0^{b}	43.8^{b}	32.8^{c}	32.2^{c}	-
Total No of eggs	283.8^{a}	235.2^{b}	215.8^{c}	202.8^{c}	192.0^{e}	160.0^{f}

Within a row means followed by a common letter are not significantly different at 5% level by DMRT.

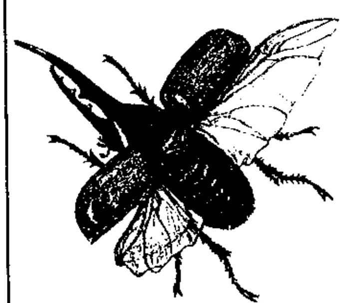
Table 2. Food utilization efficiency measures of M. pustulata *on different flower parts of* H. rosasinensis.

Nutritional parameters	**Whole flower**	**Petals + androecium**	**Petals + gynoecium**	**Petals**	**Androecium**	**Gynoecium**
CI (g)	8.33^{a}	6.85^{b}	6.13^{b}	5.36^{c}	4.86^{c,d}	3.92^{d}
RGR (g)	0.74^{a}	0.58^{b}	0.51^{b,c}	0.47^{c}	0.36^{d}	0.27^{e}
AD (%)	57.9^{a}	59.66^{c}	61.03^{b,c}	62.45^{b}	63.29^{a,b}	65.57^{a}
ECI (%)	12.94^{a}	10.3^{b}	9.41^{b,c}	8.4^{c}	8.36^{c}	6.33^{d}
ECD (%)	23.32^{a}	21.54^{b}	19.33^{c}	17.39^{d}	17.29^{d}	15.6^{e}

Within a row means followed by a common letter are not significantly different at 5% level by DMRT.
CI - Cosumption Index; RGR - Relative Growth Rate; ECI - Efficiency of Conservation of Ingested food; ECD Efficiency of Conservation Of Digested food

Table 3. Biochemical analysis in the flower parts of H. rosasinensis

Biochemical components	**Petals**	**Androecium**	**Gynoecium**
Protein (μg/100 mg)	57.3^{a}	48.9^{b}	41.1^{c}
Carbohydrate (μg/100 mg)	63.0^{a}	54.9^{a}	49.2^{c}
Lipid (μg/100 mg)	21.2^{a}	20.6^{ab}	19.1^{b}
Nitrogen (μg/100 mg)	0.987^{a}	0.745^{b}	0.684^{c}
Water (g)	76.5^{a}	53.42^{b}	46.1^{c}
W/N (g)	77.22^{a}	71.03^{b}	66.29^{c}



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