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NUTRITIONAL ASPECTS OF THE DEVELOPMENT OF *ATHALIA PROXIMA* KLUG. GRUBS, DURING DIFFERENT STAGES

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The nutritional aspects of the development of *Athalia*-grubs fed on radish leaves, in the laboratory, are discussed. 99.5% of the variations in grub-development were found to be related to the food ingested (F.I.), its approximate digestibility (A.D.) and the efficiency of the conversion of ingested (E.C.I.) and digested (E.C.D.) food to the body tissues. The practical and theoretical implications of this work are also given.

INTRODUCTION

Discussions on the development of insects mostly imply an effect of the duration and rate at which it proceeds. The nutritional aspects are either never collated with changes in development or their exact impact on them, never discussed (Bailoy, 1976; Reese and Beck, 1978). A variation observed in the development of *Athalia proxima* Klug. grubs during different stages (Table 1), thus, prompted the authors to take up these studies.

Table 1. *Development of Athalia proxima Klug. on radish, during different stages**

Stages	First	Second	Third	Fourth	Fifth	Sixth
Wt. gain (in mgs.)	0.208 a	0.751a b	1.419 b	4.834 d	3.827 c	0.000 a**

*Personal observations

**Significant at 1% level of probability

N.B. Any two values not having a common superscript are significantly different at 5% level of probability.

The main aim, however, was to see whether any of the indices of nutrition like F.I., A.D., E.C.I. and E.C.D. are closely related to the changes reported above. If so, in what way and to what degree.

MATERIALS AND METHODS

A lot of 30 freshly emerged larvae of *Athalia proxima* Klug. were fed on

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the top-leaves of field-grown radish, the *Raphanus sativus*. The larvae were kept in paired petri-dishes and fed, individually, on a weighed amount of food, which was replaced after every 24 hours. This routine was followed throughout the larval life and a continuous record of the gain in dry weight of grubs at 70±1°C as well as of the food ingested and egested, was kept.

The indices of nutrition, viz., Approximate Digestibility (A.D.), the Efficiency of Conversion of the Ingested (E.C.I.) and Digested (E.C.D.) food to the body tissues were calculated after Bailey (1976) and a multiple comparison of their means is presented in Table 2. The significance of the difference in mean values was calculated with the Duncan's Multiple Range Test and the correlation, where possible, established.

Table 2. *A multiple comparison of the means of weight-gain and different indices of nutrition in Athalia proxima Klug. grubs, at different stages.*

Stage	Wt. gain (mg)	F.I. (mg)	A.D. (%)	E.C.I. (%)	E.C.D. (%)
First	0.208** a	23.938** ab	94.731** c	0.937** a	1.000** a
Second	0.751 ab	31.750 bc	94.763 c	2.443 b	2.585 b
Third	1.419 b	35.577 c	88.634 c	3.740 c	4.520 c
Fourth	4.834 d	58.297 d	79.381 a	9.747 e	13.926 e
Fifth	3.827 c	76.840 e	82.872 b	5.523 d	6.929 d
Sixth	0.000 a	16.490 a	91.953 d	0.000 a	0.000 a

**Significant at 1% level

N.B. Any two means not having a common superscript are significantly different at 5% level of probability.

RESULTS AND DISCUSSION

A perusal of the data (Table 2) shall reveal that the food ingested, its approximate digestibility and the efficiency of conversion of the ingested and digested food to the body weight varied highly significantly with the stage of *Athalia*-grub development. Although the changes, in each case, preserved their individual pattern, they were found to be positively correlated with the grub-development except in the case of A.D. which was negatively, so (Table 3).

A highly significant correlation of the nutritional indices with the gain in body weight of grubs would suggest that the changes in grub-development during different stages were closely related to the reciprocal changes, in the indices. The significance of the regression equation fitted (Table 4).

Table 3. *Correlation coefficient of the weight gain and various indices of nutrition in Athalia proxima Klug. grubs.*

Characters	1	2	3	4
1. Wt. gain				
2. F.I.	0.9081**			
3. A.D.	−0.9598**	−0.8360**		
4. E.C.I.	0.9629**	0.7919**	−0.9116**	
5. E.C.D.	0.9545**	0.7555**	−0.9152**	0.9961**

*Significant at 5% level. **Significant at 1% level.

Table 4. *Magnitude of the combined influence of F.I. (X_1), A.D. (X_2), E.C.I. (X_3) and E.C.D. (X_4) on the gain in body weight of Athalia proxima Klug. grubs, during different stages and their mathematical relationship.*

Estimates	Value
1. Coefficient of determination (R^2)	0.9953
2. Coefficient of correlation (R)	0.9976
3. Regression equation	$Y = 9.156 + 0.028X_1 - 0.104X_2 + 0.003X_3 + 0.160X_4$**

**Highly significant at 1 level of probability.

further suggests that the changes in the body weight of grubs, under reference in these investigations, were dependent upon the F.I., A.D., E.C.I. and E.C.D. A variation in the magnitude of the changes expressed for each of these characters, in the regression equation, would, however reveal a difference in their ultimate influence on the grub-development.

No difference in the observed and calculated estimates (Table 5) expressed by a non-significant Chi-square value of 0.0081 would indicate that the mathematical relationship established between the grub-development and various indices for their nutrition, was correct.

A value of 0.9953 for R^2 (Table 4) would indicate that 99.5% of the changes observed in the development of *Athalia proxima* Klug. grubs, from one stage to another, were due to these indices.

Thus, it could be concluded from a nutritional view point that 99.5% of the development of *Athalia Proxima* klug. grubs, during different stages, was affected by the F.I., A.D., E.C.I. and E.C.D. and that it was positively correlated to them all except to the approximate digestibility, which was negatively correlated.

Table 5. *The observed and estimated changes in the gain in body weight of Athalia proxima Klug. grubs, during different stages.*

Stage	Observed wt. gain	Estimated wt. gain
First	0.208	0.137*
Second	0.751	0.611
Third	1.419	1.668
Fourth	4.834	4.789
Fifth	3.827	3.814
Sixth	0.000	0.000

* Values calculated with regression equation:
$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4$; where,
Y = wt. gain, x_1 = F.I., x_2 = A.D., x_3 = E.C.I. and x_4 = E.C.D.

The relationship established between the grub-development and various indices of food consumption is exactly in line with that reported by Bailey (1976) in the case of *Mamestra configurata* larvae fed on four hosts. Although, the young larvae of *Athalia* like those of *Mamestra* digested the ingested food better than the old ones. their higher respiratory rate like those of many young larvae (Hinton, 1971; Bailey and Riegert 1973) may have used most of the digested materials for maintenance purposes and spared comparatively very little for conversion to the body tissues. Such a situation, would definitely decrease the E.C.I. and E.C.D. which would result in a lower weight-gain in the younger stages compared with the older ones and would, thus, support the present conclusions.

Although the present studies are more of a fundamental than of a practical interest, a significantly higher food ingestion by the older larvae compared with the younger ones would suggest that the *Athalia* larvae become more harmful during the later stages of their development. Hence, it shall be advisable to control them as soon as they hatch out or even much before that. On the academic side, however, lack of any information on the nutritional aspects of the insect development in the standard text books like "THE INSECT" by Chapman (1975) would call for its special reference in the relevant sections.

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