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THE SECRETORY CYCLE OF INVERTASE IN THE MIDGUT AND CAECA TISSUE OF *LOCUSTA MIGRATORIA* L. IN RELATION TO MOULTING

THE information on various aspects of the digestive physiology in insects (Uvarov,[5] Krüger,[2] Wigglesworth,[7] Roeder *et al.*[3] and Waterhouse[6]) does not make any mention of the secretory condition of the midgut in relation to moulting. However, in *Tenebrio molitor*, Dadd[1] has recently studied the protease activity of the midgut with a view to record variations with respect to age and feeding condition. In the present work *Locusta migratoria*—an insect with incomplete metamorphosis—was selected against *T. molitor* which undergoes complete metamorphosis, to record the variation of invertase activity in the midgut and cæca tissue of individual insects belonging to various age groups starting from the newly moulted 5th instar hoppers to the ten days old adults.

The method used for the determination of invertase activity was based on the colorimetric method of Sumner,[4] which was modified to work quantitatively.

It shows that in the newly moulted hoppers the invertase activity both in the midgut and cæca tissue extracts is negligible. Later, in the continuous presence of food both the tissues show remarkable increase in the invertase activity which reaches its maximum on the fourth post-moult day. Thereafter, it gradually declines and becomes almost negligible at the end of the nymphal period (Fig. 1). In the newly emerged adults also, the invertase activity in both the tissues remains negligible. It undergoes increase progressively up to the second or third post-emergent day; thereafter the activity fluctuates but the general trend is on the increase. These variations are more pronounced in the females than in the males.

It is suggested that the progressive increase of the invertase activity in *L. migratoria* after moulting is one of the facets of metabolic activity to provide enough reserve material for the growth of the hoppers and for laying down the new cuticle for the next moult. This slow metabolic process is further speeded up after the emergence of the adult, perhaps to meet the

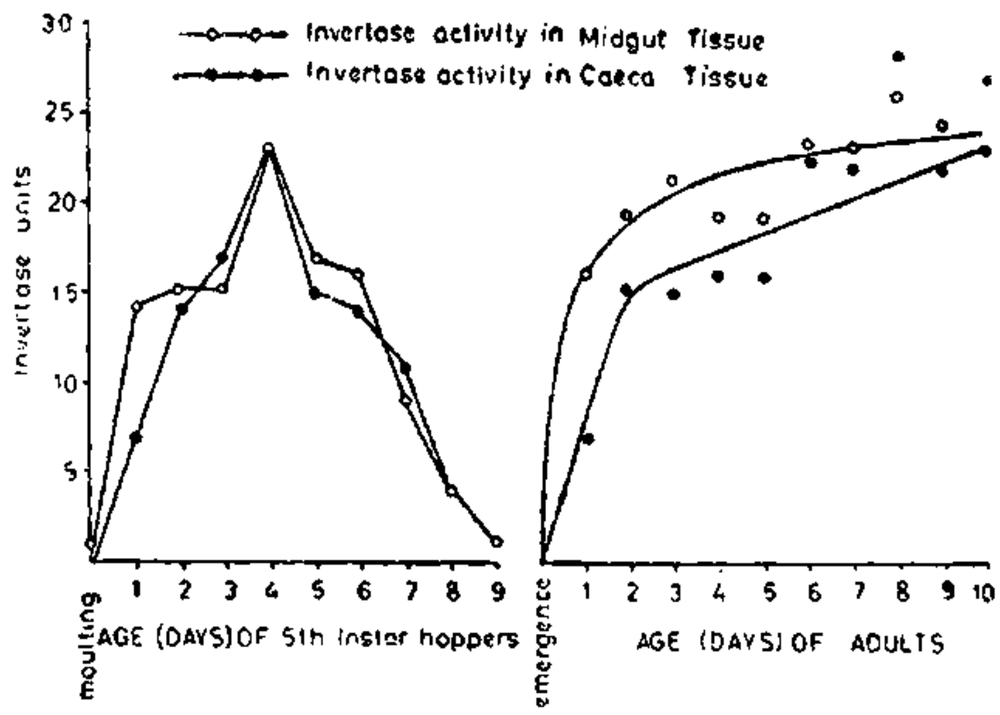

FIG. 1. Changes in invertase activity in the midgut and cæca tissue of 5th instar hoppers and adult *Locusta migratoria* L.

demand of material in greater quantity to cope with the growth and the maturation of the reproductive organs.

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PERSISTING NUCLEOLI AND MICRONUCLEI IN THE MITOTIC CELLS OF *PISUM SATIVUM* LINN.

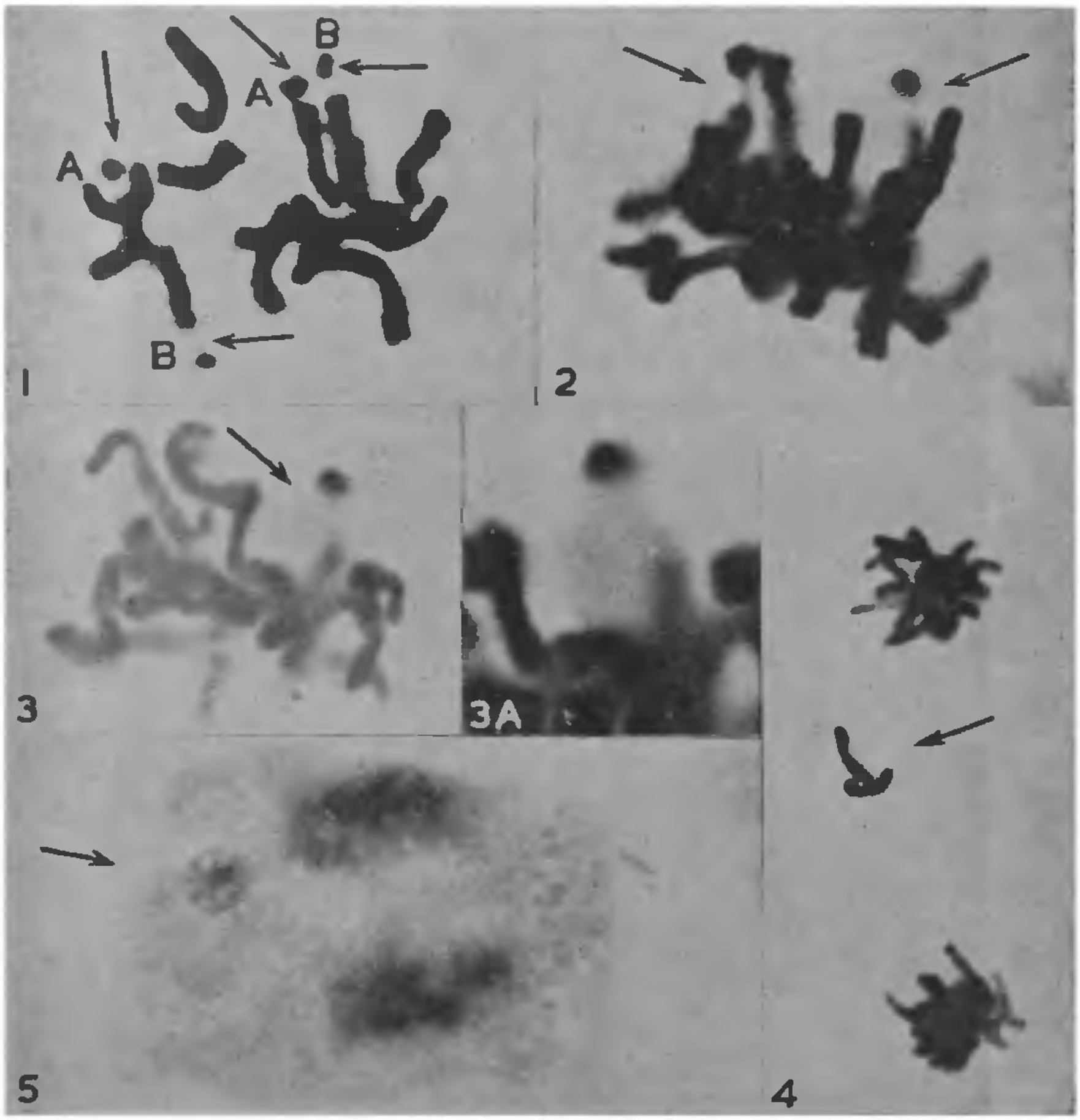
NUCLEOLI persisting till the metaphase of mitosis is common in Leguminoseæ.[1-3] These offer better opportunities for a critical study of the satellite-nucleolus association[3,4] than telo- or pro-phase stages. The earlier suggestion of Heitz that the nucleolar matter surrounds the SAT-thread is being confirmed by recent investigations.[3,4,6,7]

Differences of opinion exist whether in the mitotic cells of *Pisum sativum* Linn. (1) the nucleoli originate in relation with the centromere[1] or the satellite[8] and whether, (2) they persist till metaphase. In germinated seeds, the time when the maximum number of cells are in division in roots of a specific age is determined by the temperature of the environment. It was thought desirable, therefore, to

control these factors by transferring the seeds of a commercial variety kept in running water till the emergence of the radicles, to an incubator maintained at 30° C. When the germination had proceeded for another 16 hours, the tips of the roots were excised and fixed in formaldehyde-acetic-alcohol (1 : 1 : 3) for 24 hours. The above fixative gave good preservation and staining of the chromosomes as well as the nucleoli.[3,9] In material handled in this manner, large number of cells were consistently in division between 9–15 and 9–30 a.m.

soln. of hæmatoxylin (Dark Variety of Gurr) for 15 min., were teased into small bits in a drop of 45% acetic acid, squashed under a coverslip and sealed with paraffin wax.[10] The photographs presented are from such temporary mounts.

The two pairs of satellites are very clear in the metaphase plate presented as Fig. 1. One pair of SAT-grains (A in Fig. 1) is bigger than the other (B). In side views of the metaphase plate, the satellites could be clearly distinguished since they project out of the



FIGS. 1–5. Fig. 1. Metaphase with 2 pairs of satellites. Note the difference in the size of the satellites, × *ca.* 2,050. Fig. 2. Metaphase. The satellites are seen projecting out of the group, × *ca.* 2,250. Fig. 3. Persisting nucleolus at metaphase, × *ca.* 2,450. Fig. 3 A. Nucleolar matter forms a collar around the SAT-thread, × *ca.* 4,150. Fig 4. Late anaphase. Note the pair of lagging chromosomes, × *ca.* 3,500. Fig. 5. Telophase. Micronucleus with a nucleolus, × *ca.* 1,550.

The fixed roots hydrolysed in N HCl at 60° C. for 10–15 min., mordanted in 4% ferric ammonium sulphate for 15 min., stained in a 0·5% group (arrows in Fig. 2). Judged on that basis, the persisting nucleolus in Fig. 3 shows a very intimate relationship to the SAT-chromo-

some. The nucleolar matter forming a sheath to the SAT-thread in Fig. 3 A is reminiscent of similar observations in *Allium cepa*[4] and *Cicer arietinum*.[3] In the roots of *P. sativum* investigated, the nucleolus is associated with the satellite[8] and not the centromere.[1]

Several instances of lagging chromosomes and micronuclei were observed in the squashes of one of the roots. These became interesting because such anomalies have been observed previously only during meiosis in *P. sativum*.[11, 12] Figure 4 shows two lagging chromosomes. Since instances of polysomic cells with $2n + 2$ or 3 chromosomes have been observed in the squashes of some roots, the lagging of chromosomes and the consequent micronuclei formation have to be considered as an accentuation of the rare mitotic abnormalities. The micronucleus in Fig. 5 has a well-defined nuclear membrane and a nucleolus. These Figures consitute perhaps the first record of the formation of micronuclei during mitosis in the normal roots of *P. sativum*.

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POTASSIUM NITRATE AND CARBOHYDRATE CONTENTS OF *ARGEMONE MEXICANA* LINN. AT DIFFERENT STAGES OF ITS GROWTH

HIGH contents of potassium nitrate and carbohydrates along with other organic acids seem to be vital factors responsible for making *Argemone mexicana* a good soil amendment.[1] Therefore a comprehensive study of potassium nitrate and carbohydrates in the plant at different stages of its growth was undertaken.

The amount of potassium nitrate in the plant has been observed to rise steadily as the growth advances, the optimum amount being reached at the flowering stage. Naturally-dried plants, collected before rains, showed little difference in their potassium nitrate content as compared to the green plants. But when collected after rains, they showed a marked decrease in the content which might be attributed to the fact that the rain washes out potassium nitrate of the dry plants. It has also been noted that the dried and powdered plants do not lose amount of potassium nitrate even when stored for a considerable length of time, for about a year. Plants, reaching their maturity at lower height than the usual one, have been found to contain higher percentage of potassium nitrate. The amount of potassium nitrate in the plants has also been found to vary with the different localities where the plants were collected from, the variation ranging from 1·1 to 2·9%. Relation between soil nutrients and potassium nitrate present in the plant is under investigation.

Carbohydrate contents of *A. mexicana* differed little at the different stages of its growth. Percentage of total reducing sugars (calculated as glucose)[2] after hydrolysis remained almost the same.

The results are summarised in Table I.

TABLE I

Average height of the plant	KNO_3 (dry wt. basis)	Total reducing sugars after hydrolysis (Zero moisture basis)
	%	%
2·5 cm.	1·0	8·6
15 cm.	1·1	9·3
20 cm.	1·6	9·8
45 cm. (Flowering stage)	2·0	10·4
90 cm. (Fully matured stage)	2·0	10·4
30 cm. (Flowering stage)	2·7	9·7
30 cm. (Fully matured stage)	2·7	9·7
Naturally-dried plants	2·5	10·3
Naturally-dried plants collected after rains	0·2	10·0
Stored powdered plants	2·3	9·2

Water-soluble polysaccharides.—The dried plant material, after successive hot extraction with methanol and acetone, was finally extracted with water. Polysaccharides were precipitated from the water extract by the addition of alcohol. Yield (crude product), 1·8%. Precipitated product was hydrolysed with N H_2SO_4 for 8 hours. The hydrolysate, after usual neutralization, revealed the presence of galactose and arabinose by paper chromatography, using