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biológiája

Natural History of the garden slug *Anadenus modestus*
Theobald (Gastropoda: arionidae)

ABSTRACT: The slugs *Anadenus modestus* Theobald are very common in the kitchen gardens of Darjeeling, West Bengal, India. They are nocturnal but sometimes they become active in day time, in cloudy days, following heavy shower. Of the several plant species of the garden these slugs feed mostly on the cash crop christophine [*sechium edule* (Jacq.) Sw] and rarely on the leaves of potato. Though they are hermaphrodite they laid eggs following mating. The eggs are laid either singly or in a string. They are much selective in selection of egg laying sistes. The eggs measured 2.5-3.0 mm in length, 2.3-2.8 mm in width and 16-20 mg in weight. The eggs required 12-16 days for hatching.

Key words: Slugs *Anadenus modestus*, Darjeeling (India), natural history.

Introduction

The occurrence of different species of *Anadenus* on the southern slopes of the Himalayas, extending west of Kashmir and east of China is on record (RUNHAM and HUNTER, 1970). GUDE (1914) has given the description of

7 species under the genus Anadenus from the Indian Himalayas. In course of description of different slug species Gude (1914) has also mentioned the presence of Anadenus modestus in Darjeeling, West Bengal, India. However, since then, no information on this slug species is available. In the recent years, the present authors have noted the occurrence of A. modestus in different vegetable and flower gardens in Darjeeling. Since they are causing much damage to the economically important plants in the area concerned the authors have noted some fundamental data on the ecology, biology and economics of this slug species during the period of last two years 1989-1990 and the findings are described in this paper.

Material and methods

Observations on the activities of the slugs A. modestus have been made from different slug infested gardens of Darjeeling town area (altitude 2000 m) West Bengal, India both in day and night hours in different seasons of the years 1989 and 1990. A three celled torch was used to study the activities of the slugs in night hours.

Observations

Habit and habitat:

The slugs A. modestus (Fig. 1) are very common in the vegetable and flower gardens. They are cryptic and usually spent the sunny hours of the day under covers. With the onset of darkness in sunny days or in day hours in rainy cloudy days they were seen to come out of their hiding places. In certain cases they were found active throughout the period of 24 hours. With the onset of

winter they became sluggish. In the winter months (October - March) when atmospheric temperature was ranged from 0.8-14.5 C the slugs were seen to take shelter at the leaf base of different garden plants viz. Crinum sp., Zantedeschia sp. etc. where accumulation of a little amount of water either due to rains or dewdrops could be available. The slugs were always seen in close contact of that water.

Food and feeding

The slugs were seen to feed mostly on the leaves of christophine (Sechium edule) (Figs. 2,3). Sometimes, feeding on potato leaves has also been observed. They are used to attack the leaves mostly from the margin of the lamina though attack at other points is not uncommon. While the slugs are much interested feeding on live leaves, decomposed and semidecomposed christophine leaves are not spared. At a time as many as 15-49 individuals were seen feeding on a single leaf. Usually, in sunny days, the slugs started feeding between 16:00-17:00 hours and the same was completed by several spells before they moved to the shelter prior to dawn of the next day.

Breeding

The slugs A. modestus are hermaphroditic. In nature, they became sexually mature at the age of 148-160 days (between 25.0 and 30.0 mm in body length, 4.0 and 5.5 mm in body width and 220-250 mg in body weight). Mating is reciprocal. Usually the mating partners were similar in size. Following mating, the slugs laid the first clutch between 3rd and 5th day. An

egg-bearing slug individual could easily be recognised by observing the bulged portion on the dorsal surface of the body at the site where the egg-pouch is located (Fig. 4.). The eggs are laid either singly or in a string (Figs. 5,6). The subsequent clutches were laid with the progress of age of the slug individual. In case of egg production in the form of a string no nesting device was ever followed by these animals and in all cases the egg masses were deposited on the moist soil (40-50%) surface exclusively exposed to sky. But in case of deposition of clutches with isolated eggs the slugs were careful in selecting protective sites for deposition of egg mass. The protective sites are the under surfaces of stones, bricks, wooden logs etc. or the depression or hole on the soil surface that are always protected by dense vegetations. The eggs are milky white in colour and oval in shape. The size of the eggs varied from 2.5-3.0 mm in length and 2.3-2.8 mm in width. The weight of the eggs ranged from 16-20 mg. The number of eggs of a clutch varied from 6-18. usually the number of eggs was minimum in first clutch and maximum in the last clutch. Irrespective of the length of the string, the distance between two eggs was never less than 3 mm and more than 8 mm. The eggs are connected with each other by a membranous thread which seems to be extension of the outer covering of the egg. The eggs hatched between 12th and 16th day following deposition. The newly hatched A. modestus are measured 1.2-1.8 mm in body length and 15-17 mg in body weight.

Discussion

The slugs A. modestus are extensively adapted to high altitude conditions. Since the weather in Darjeeling, usually remains cloudy in day time, the slugs, being nocturnal, have adapted themselves to utilise the day hours to perform various activities in addition to the night hours. As the temperature accelerates the process of development, deposition of egg masses open to the sky seems to be related with the fall of sunlight. In Darjeeling, raining is a common feature almost in all seasons. Sometimes, drizzling is accompanied by bright sunshine but the phenomenon of heavy shower followed by bright sunshine is unusual. Since there is every possibility of dispersal of eggs to different sites due to shower and dispersed egg may be buried in the loose soil due to repeated shower the slugs have developed the art of deposition of eggs in a string. This is justified from the fact of deposition of eggs singly either under the protective device or inside the holes on the ground. Because, during July - August period the temperature in Darjeeling is quite high (21.2-27.5 C) and the eggs usually hatch within a short period without direct contact of sunlight. For the said reason, the slugs deposit eggs under these covers and as there is no possibility of these eggs to come in contact with direct rainfall these creatures do not take the trouble to construct the string to save the eggs from dispersal. Such devices to protect the eggs from destruction have been noted in the slugs Laevicaulis alte (FÉRUSAC) (RAUT and PANIGRAHI, 1988) and Mariaella dussumieri (GRAY) (RAUT *et al.*, 1990). This suggests that the slugs are much sensitive to the conditions and

are extremely adapted to the conditions in respect to the care of eggs and/or young ones is concerned. In fact, such device enabled the slugs A. modestus to raise the population density to a high level. This has turned A. modestus to be a serious pest. The slugs like other terrestrial gastropods feed on a number of food-plants (HUNTER et al., 1968; GODAN, 1983; RAUT and MANDAL, 1984; RAUT and PANIGRAHI, 1990; PANIGRAHI and RAUT, In press). The degree of damage caused by the slug to a plant species determines the pest status of the concerned slug species. As the christophine is an important cash crop in Darjeeling and the same is grown almost in every kitchen garden, the slugs A. modestus have adapted themselves to thrive only on a single food-plant species. This sort of adaptation is dangerous so far damage to the cash crop and economic loss to the farmers are concerned. Because of their adaptation to feed almost on a single plant species the slugs A. modestus are now available in all the christophine cultivated gardens throughout the hilly tracts of Darjeeling. Since christophine is cultivated in almost all gardens of Darjeeling hill area and the extent of damage is of serious concern an effective control measure of A. modestus is urgently needed.

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EXPLANATION OF FIGURES

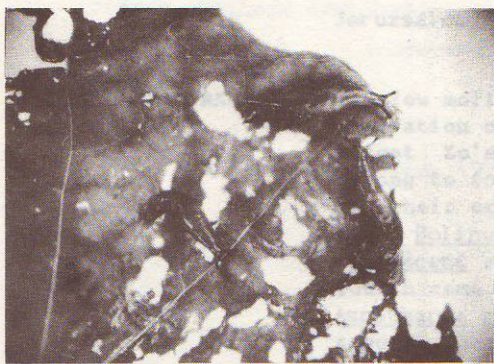
- Fig. 1. The slug Anadenus modestus
- Fig. 2. Anadenus modestus feeding on the leaf of christophine (Sechium edule)
- Fig. 3. The nature and extent of damage to christophine (Sechium edule) leaf caused by the slug Anadenus modestus.
- Fig. 4. An egg-bearing Anadenus modestus (bulged portion indicates the presence of egg-pouch).
- Fig. 5. Eggs of Anadenus modestus.
- Fig. 6. Egg string of Anadenus modestus.



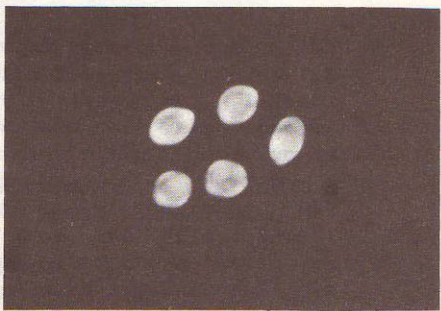
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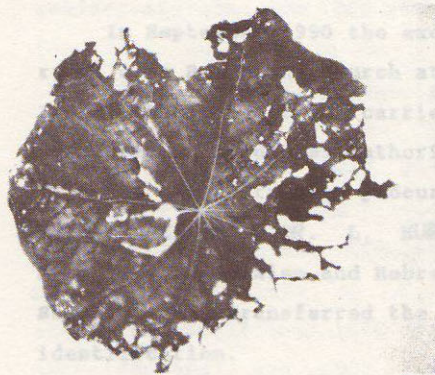
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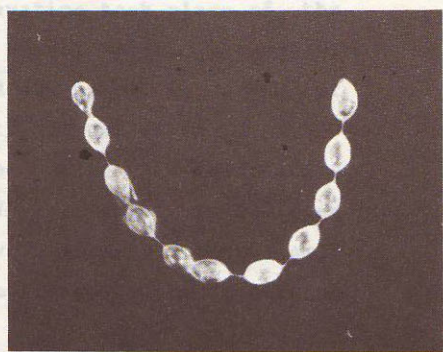
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