Investigations on the Biology and Ecology of Oligota minuta Cam. (Coleoptera: Staphylinidae) a Predator of Mononychellus tanajoa (Bondar) (Acari.: Tetranychidae) in the Neotropics

Author: M. Yaseen, Commonwealth Institute of Biological Control, Curepe, Trinidad, W.I.

ABSTRACT

The biology of Oligota minuta has been studied as part of an investigation seeking to find and evaluate predators of Mononychellus tanajoa. The egg, larval and pupal stages last 2.0 to 3.0; 9.0 to 10.5, and 4.0 to 5.0 days, respectively, at a temperature of 26.8° ± 2.2°C. It is adapted to feed on mites infesting cassava. The larvae consumed 59.1 ± 6.5 mites of 52.8 ± 7.2 eggs of M. tanajoa. Larvae and adults both feed on eggs as well as active mite stages. The species survive periods of low host density on cassava by moving on to other hosts and has attributes of a promising predator for trial introduction against the mite in Africa.

Introduction

Mononychellus tanajoa (Bondar) was discovered in Uganda in 1971 (Lyon 1973). Since then, the mite has rapidly spread and is now in almost all cassava growing areas in the Afrotropics. The mite was described from Brazil (1939). Doreste (1981) has split it into three: tanajoa, progresivus and manihoti. Recent investigations in Kenya indicate the presence of tanajoa and progresivus in East Africa (Yaseen et al., 1982). The same two species also occur in Nigeria, West Africa (Flechtman, pers. comm.)

The mites of tanajoa complex cause severe damage in the Afrotropics. These are not considered serious pests in areas of natural distribution and it has been assumed that predators keep populations below injurious levels. A survey for the natural enemies of these mites in the Neotropics by the Commonwealth Institute of Biological Control, Trinidad, is to evaluate them for trials in Africa. Yaseen (1982) and Yaseen and Bennett (1976) have reported several predators including 14 phytoseiid mites, 6 coccinellids, 3 cecidomyiids, 4 staphylinids, 1 anthocorid and a Thysanopteron.

Oligota minuta Cam. is one of the important predators of tetranychid mites infesting cassava. It was described by Cameron (1931) from specimens collected from Trinidad; as the name implies, it is very small. Frank (1972) has revised the Caribbean species and clarified records in the literature thus: Cameron's collections from Jamaica were labelled as O. laxata and recorded as such by

Blackwelder (1943) and specimens from Cuba were also misidentified and recorded as O. centralis by Bierig (1934).

Distribution

O. minuta is widespread in the Neotropics and was previously known from Antigua, Cuba, Grenada, Jamaica, and Trinidad (Blackwelder 1943, Frank op. cit.). During present investigations it was also encountered in the Bahamas, Montserrat, St. Kitts, and Tobago in the Caribbean and Brazil, Colombia, Ecuador, French Guyana, Guyana, Surinam, and Venezuela in South America.

Hosts

This staphylinid is specially adapted to feed on mites and is known to attack several spider mites including Oligonychus pratensis (Banks), Tetranychus tumidus Banks and Tetranychus spp. on several hosts (Frank op. cit.). During present surveys it was found on cassava in association with Mononychellus caribbeanae (McGregor), M. mcgregori Flechtmann and Baker, M. tanajoa, M. progresivus Doreste, M. manihoti Doreste, Oligonychus peruvianus (McGregor), Tetranychus sp. probably urticae Koch and Tetranychus sp. in various areas in the Caribbean and South America.

Descriptions of immatures stages

Measurements are given in Table 1.

Table 1. Body measurements of immature stages of O. minuta.

Stage	No. examined	Length (mm)		Width (mm)	
		Range	Mean ± SD	Range	Mean ± SD
Egg	30	0.25 - 0.32	0.28 ± 0.03	0.17 - 0.21	0.19 ± 0.02
Larva 1st instar	25	0.63 - 0.97	0.78 ± 0.11	0.15 - 0.18	0.16 ± 0.01
2nd instar	25	1.27 - 1.91	1.49 ± 0.18	0.23 - 0.38	0.29 ± 0.04
3rd instar	25	1.61 - 2.29	1.87 ± 0.21	0.32 - 0.42	0.38 ± 0.03
Pupa	20	0.77 - 1.18	0.90 ± 0.11	0.38 - 0.54	0.46 ± 0.04

Biology

A laboratory culture of O. minuta was established by confining adults collected from cassava on potted lima bean plants infested with Tetranychus tumidus or T. urticae. Mated females were placed on a young plant with only two or three heavily infested leaves to obtain eggs. These were removed from the bean plant and placed on a section of cassava leaf in individual cages of clear plastic petri dishes 25 mm in diameter and 5 mm deep with a piece of moist filter paper below the cassava leaf to provide humidity. Edges of the dishes were coated with petroleum jelly before covering to prevent escape of larvae. Mononychellus eggs or immature stages were placed on a section of cassava leaf and offered to the larva. The amount of food consumed was recorded and cassava leaf replaced daily by a fresh leaf with known numbers of prey. The cages were observed in the morning and evening. All observations were at laboratory temperatures of 26.8 ± 2.2°C and relative humidity varying from 90.5% in the morning to 55% in the afternoon.

Life history

After hatching, the larva remained inactive near the egg shell for about an hour before starting to search for prey. Before moulting, the first and second instar larvae became motionless and adheared firmly to the leaf surface by the last abdominal segment. This period of inactivity lasted for a few hours and the next instar emerged through a longitudinal slit along the anterior half of the dorsum. The freshly moulted second or third instar larvae also remained motionless for about an hour before resuming the search for prey. The third stage larva ceased all movement after completion of feeding and firmly attached the last abdominal segment to the leaf surface resting for more than half a day as a prepupa. In the absence of adequate pupation sites, these failed to pupate and perished on the leaf surface. When provided with moist folded towelling tissue they readily moved and pupated in the tissue folds. Under field conditions, pupae have not been seen on the plant; presumably pupation takes place in the soil. The duration of immature stages is given in Table 2.

Table 2. Duration of immature stages of O. minuta.

Stage	No. observed	Days Range	Mean ± SD
Egg	50	2.0 - 3.0	2.8 ± 0.3
Larva	37	9.0 - 10.5	9.9 ± 0.7
1st instar	48	2.0 - 3.5	2.7 ± 0.5
2nd instar	42	2.5 - 3.5	3.1 ± 0.4
3rd instar	37	3.4 - 4.5	4.2 ± 0.3
Pupa	37	4.0 - 5.0	4.4 ± 0.5
Total	37	16.0 - 18.0	17.1 ± 0.6

The adult emerged through a mediodorsal slit in the anterior half of the pupal skin. It was light brown at first, remaining near the pupal skin for several hours until the integument hardened and became dark. On becoming active the adults search for prey. Mating took place a day after emergence. The male and the female faced opposite directions during mating. Mating lasted for several minutes and was repeated several times by the same pair. Oviposition began two to three days after mating. Although a few eggs were laid along the leaf mid-rib, most were deposited in the open among mites on the lower surface. Females lived up to 16 days and laid an average of 20.8 ± 3.1 eggs. Males lived up to 12 days.

Feeding

Larvae were fed on Mononychellus eggs or active immature stages or both. Newly hatched larvae prefer mite eggs to active stages perhaps because their mandibles are comparatively weak and only pierce the body cuticle with difficulty. Second and third instar larvae prey on both eggs and active stages. On contacting prey the larvae pierce the egg shell or the hysterosoma of the mite with the mandibles, suck the body contents making a series of regurgitation-like movements, and discard the exoskeleton after consuming the internal tissues. An egg or an immature mite stage took approximately 2.5 to 4 minutes to consume and a female mite up to about 8 minutes. The mites made no effort to escape when attacked but became motionless and succumbed. After consuming a host the larva usually re-

mained stationary for 10 to 15 minutes before resuming search for prey but sometimes continued searching without rest. The first prey encountered on a densely infested leaf was not necessarily attacked. Adults, which were more active than larvae, preyed on both eggs and mites and consumed the exoskeleton of the mite as well.

Adults consumed 97-142 eggs and mites in 7-16 days with an average of 119.9 ± 15.4 and average daily consumption of 10.9 ± 2.1 mites and eggs.

Field observations

In Trinidad O. minuta is regularly associated with tetranychids on cassava. While it attacks Tetranychus urticae on cassava it was observed that heavy infestations of this mite on tomatoes (Lycopersicum esculentum) and beans (Phaseolus spp.) and several other plants with highly pubescent leaves in adjacent plots were seldom attacked. However, T. urticae infestations on cassava are infrequent and usually confined to old plants with retarded growth and poorly nourished leaves. Young vigorous plants are attacked mainly by Mononychellus spp. and this constitutes the principal prey of the staphylinid.

Sampling of O. minuta on cassava showed that seasonal incidence is synchronized with that of tanajoa complex. The mite were scarce during sustained heavy rains from mid-July until December or January and the predator was also rare during this period. During the dry season in March when the populations of mites showed upward trends on cassava, O. minuta adults appeared and fed on the mite. It gradually increased in numbers and fluctuations in the predator population closely related with those of the mite. Fortnightly observations in the southern plains of Trinidad during May to August 1974 showed an average of 15.5 O. minuta larvae per leaf when the average host density was 2,571 per leaf during May to mid-July, decreasing to 6.2 per leaf as the host population fell to 1,058 per leaf from mid-July to mid-August. The mite population was completely dislodged during a tropical storm accompanied by heavy rains in the third week of August and when the plants were examined on August 27, the predator population had also completely disappeared.

Regular examination of samples consisting of the top 15 leaves from five heavily infested and five moderately infested cassava plants during the dry season showed 73-120 O. minuta larvae and adults on the former and 28-44 on the latter. Numbers of predators also vary in relation to the infestation levels on leaves of individual plants and 79.7% to 86.7% of the predator population occurred on leaves 6-10 which harbored most of the mite populations; the eight leaf carrying the largest number of mites had 25.8% to 26.3% of the predators. Numbers of adults on densely infested leaves are usually higher in the early part of the morning.

Weekly counts in an experimental plot containing 10 cassava varieties in 1975 indicated that differences in the predator population were related more closely with host density than with cassava variety. Larger numbers occurred on varieties Black Stick and Brown Stick which harbored high mite populations than on variety Maracas Black Stick which had few mites. During the peak period of mite population in June and July, variety Black Stick which harbored the highest average mite population of 2,383 and also the highest average predator population of 22 per sample of leaves 6-10 in June, showed a lower host density of 1,885 mites per sample in July while variety Brown Stick, which had a mite population of 1,942 and 16 O. minuta per sample in June, showed a higher (2,517 per sample) mite population in July. This suggests that when abundant, the staphylinid suppresses the mite populations.

Discussion

Oligota minuta is widely distributed in the Neotropics thereby indicating an adaptability to a wide range of habitats, climatic conditions and prey mites. The population density seems closely associated with that of its prey, M. tanajoa and other tetranychids on cassava in Trinidad and several other areas in the Neotropics. Its activity is well synchronized and its distribution pattern similar to that of M. tanajoa. It is voracious and both larvae and adults prey on eggs as well as the motile mite stages. The developmental period is short and with a fairly high reproductive potential and several overlapping generations it rapidly builds up large populations which destroy appreciable host scarcity on cassava by moving over to mites on other plants. These are characters considered promising for a predator of tetranychids by McMurtry et al. (1970). Consequently, it merits introduction for trial against the mite in Africa.

Acknowledgements

Thanks to Dr. J.H. Frank, Florida Medical Entomology Laboratory, for identifying specimens of O. minuta. A financial grant by the International Development Research Centre (IDRC), Ottawa, Canada, is greatly appreciated.

References

Badgley, M.E. and Fleschner, C.A. 1956. Biology of Oligota oviformis Casey (Coleoptera: Staphylinadae). Ann. Ent. Soc. Amer. 49:501-502.

Bierig, A. 1934. Novedades de los géneros Oligota, Mann. y Euvira Sharp de la Fauna neotropica. Mem. Soc. Cubana Hist. nat. 8:113-123.

Blackwelder, R.E. 1943. Monograph of the West Indian beetles of the family Staphylinidae. Bull. US Nat. Mus. 182:viii + 658pp.

Cameron, M. 1931. Description of a new species of Oligota (Col.: Staphylinidae) from Trinidad: Ann. Mag. Nat. Hist. (Ser. 10) 8:82.

Frank, J.H. 1972. The genus Oligota Mannerheim in the Caribbean region (Coleoptera: Staphylinidae). Coleopterists Bull. 26(4):125-146.

Lyon, W.F. 1973. A plant feeding mite Mononychellus tanajoa (Bondar) (Acarina: Tetranychidae) new to African continent threatens cassava (Manihot esculenta Crantz) in Uganda, East Africa. PANS 19(1):36-37.

McMurtry, J.A., Huffaker, C.B., and van de Vrie, M. 1970. Ecology of Tetranychid mites and their natural enemies: A review (1). Tetranychid enemies: Their biological characters and the impact of spray practices. Hilgardia 40(11):331-390.

Yaseen, M. 1982. Exploration for Phenacoccus manihoti and Mononychellus tanajoa natural enemies: The challenge, the achievements. Proc. Workshop on biological control and resistance breeding to control cassava mealybug (Phenacoccus manihoti) and green spider mite (Mononychellus tanajoa) in Africa. International Institute of Tropical Agriculture, Ibadan, Nigeria, Dec. 6-10, 1982.

Yaseen, M. and Bennett, F.D. 1977. Distribution, biology and population dynamics of the green cassava mite in the Neotropics. Proc. IV Symp. Int. Soc. Trop. Root Crops, Cali, Colombia (1976) IDRC-080e:197-202.

Yaseen, M., Bennett, F.D., and Ingram, W.R. 1982. Investigations on the cassava mite Mononychellus tanajoa (Bondar) and its natural enemies in the Neotropics and East Africa. 1979-1982 Final Report. CIBC report, 14 pp.