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Distribution of Larvae of Ophionea indica Thunberg (Carabidae), a Predator of the Rice Gall Midge, *Orseolia oryzae* (Wood-Mason) in Paddy Fields of Sri Lanka

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Abstract

Populations of *Ophionea indica* larvae inhabiting the gall cavities resulting from infestation with the rice gall midge, *Orselolia oryzae* were investigated in the paddy fields of Sri Lanka. The surveys were conducted three times from 1989 to 1992 during the Yala and Maha (monsoon seasons) and early Maha (dry season) seasons. In the Yala season, the population was high in the wet zone where a mean value of 3.0 larvae per 100 galls was observed, while only 0.6 larvae per 100 galls were recorded in the intermediate zone. In the Maha season, the mean value of 0.6 larvae was recorded in the wet zone, 0.8 larvae in the intermediate zone and 0.2 larvae in the dry zone. In the dry season no larvae were detected. These results suggest that the population density of the predatory larvae in high in the wet zone in the monsoon seasons. The predators seemed to aggregate in the paddy fields where the rice gal midge pupae were abundant, because marked differences in larval catches were observed in the same district such as in the Gampaha District in the Yala season. It is assumed that the predator larvae may possibly detect the moving pupae in the gall by visual stimulus, because they bore a hole in the gall to penetrate into it to feed on prey pupae.

Discipline: Insect pest
Additional key words: aggregation, prey detection

Introduction

Ophionea indica Thunberg is a predator of the rice gall midge, *Orseolia oryzae* (Wood-Mason), an important rice insect pest in Sri Lanka. This predator is widely distributed in Asia including Japan, Taiwan, China, Vietnam, Laos, Cambodia, Malaysia, Myanmar, Sri Lanka and India[2]. Yasumatsu et al. (1975) reported that *O. indica* and *O. impressipennis* Schmidt-Goebel were predators of the rice gall midge pupae in Thailand[4]. However, we could not find any other reports on the predatory ground beetle of the rice gall midge.

This paper presents the population density of *O. indica* larvae inhabiting the galls resulting from gall midge infestation in paddy fields during different climatic seasons, Yala, Maha (wet seasons) and early Maha (dry season). The data of the first survey of *O. indica* in the Yala season in 1989[3] were used in this report for comparison with those of the second and the third surveys (Table 1).

Materials and methods

The surveys were carried out from mid-June to

The present paper was prepared on the basis of data contained in the technical reports presented in August 1989, November 1990 and June 1992 as collaborative studies between the Tropical Agriculture Research Center, Japan and the Department of Agriculture, Sri Lanka.

Table 1. Mean annual precipitation and locations where the galls of the rice gall midge were collected

Climatic zones	Districts	Annual precipitation[a] (mm)	No. of sampling sites/season		
			Yala (Wet) (1989)	Maha (Wet) (1991–1992)	Early Maha (Dry) (1990)
Wet zone	Matale	1,270	2	2	1(R)[b]
	Kandy	1,397	5	2	2(R)
	Gampaha	1,397	4	0	1
	Kegalla	1,905	2	2	4(R)
	Nuwara Eliya	2,540–3,175	0	0	1(R)
	Ratnapura	1,905	0	1	0
	Kalutara	1,524–2,540	2	3	2(R)
	Matara	1,905	0	1	0
	Galla	1,524	0	1	1
Intermediate zone	Kurunegala	1,016	3	4	0
Dry zone	Anuradhapura	762	0	2	0
	Polonnaruwa	762	0	3	0
	Hambantota	762	0	1	0

a): 75% expectancy value of annual rainfall, b): R; Ratoon crop.

early July in 1989 (Yala season), October 1990 (early Maha season) and late December 1991 to early January 1992 (late Maha season). In each survey, the galls of the rice gall midge were collected to count the number of *O. indica* larvae inhabiting them. In the Yala season the galls were collected at 15 sampling sites in the wet zone, and 3 sites in the intermediate zone. In the Maha season, the samples were collected from 12 sites in the wet zone, 4 sites in the intermediate zone and 6 sites in the dry zone. Twelve sites were selected in the dry zone in the dry season. The galls were mainly collected from ratoon crops in the dry season, since it was difficult to find rice plants at the vegetative growth stage (Table 1).

During these surveys, 8,523 galls were collected at 52 sampling sites, i.e. 164 galls per site were collected on an average. The galls were split lengthwise with a sharply pointed forceps or razor blade to observe *O. indica* larvae. The *O. indica* larvae usually crawled out fast from the galls just after dissection (Plate 1).

Plate 1. *Ophionea indica* larva, a predator of *O. oryzae*

Results and discussion

Yala season: The predatory larvae were relatively abundant in the wet zone which receives large annual precipitation of 1,270–3,175 mm. In this zone the larval density ranged from 0 to 12.2 individuals per 100 galls. In this paper, the number of larvae will be indicated as the value per 100 galls. In Gampaha District, at Kosatadeniya 12.2 larvae and in Kalutara District, at Udumulla 9.1 larvae were recorded in 1989 with a mean of 3.0 larvae for this agroclimatic zone.

In the intermediate zone with annual rainfall of 1,016 mm, 1.9 larvae were collected in a field at Batalagoda, while no larvae were collected at two

Table 2. Distribution of *Ophionea indica* larvae, a predator of the rice gall midge, *O. oryzae* in three seasons in Sri Lanka

Climatic zones	Districts	Yala (1989)[a)]				Maha (1991–1992)				Early Maha (Dry season) (1990)			
		No. of galls /sampling site	No. of predators/100 galls			No. of galls /sampling site	No. of predators/100 galls			No. of galls /sampling site	No. of predators/100 galls		
			Max	Min	Mean		Max	Min	Mean		Max	Min	Mean
Wet zone	Matale	185	1.9	1.1	1.5	251	1.0	0	0.5	61	0	0	0
	Kandy	92	1.9	0	0.3	215	2.7	0.5	1.6	103	0	0	0
	Gampaha	110	12.2	1.9	6.2	–	–	–	–	172	0	0	0
	Kegalla	92	3.2	0	1.0	219	0.9	0.5	0.7	94	0	0	0
	Nuwara Eliya	–	–	–	–	–	–	–	–	110	0	0	0
	Ratnapura	–	–	–	–	190	0	0	0	–	–	–	–
	Kalutara	164	9.1	3.4	6.0	229	0.9	0	0.5	119	0	0	0
	Matara	–	–	–	–	209	0.5	0.5	0.5	–	–	–	–
	Galle	–	–	–	–	204	0	0	0	92	0	0	0
Intermediate zone	Kurunegala	203	1.9	0	0.6	250	3.0	0	0.8	–	–	–	–
Dry zone	Anuradhapura	–	–	–	–	169	0	0	0	–	–	–	–
	Polonnaruwa	–	–	–	–	170	0.5	0	0.2	–	–	–	–
	Hambantota	–	–	–	–	203	–	–	0.5	–	–	–	–

a): From Kobayashi et al., 1990.

other sampling sites in the Kurunegala District. The mean for this zone was 0.6 larvae.

We did not observe rice plants growing in the fields in the dry zone with an annual rainfall of 762 mm in the Yala season (Table 2).

Maha season: A maximum value of 2.7 larvae was recorded at Peradeniya in the Kandy District in the wet zone in 1992. No predatory larvae were observed in Ratnapura and Galle Districts. Mean value was 0.6 larvae for this agroclimatic zone.

In the intermediate zone, the predator larvae were found only in a paddy field at Kathupota, where 3.0 larvae were observed on 3 January 1992. No larvae were observed at the other three sampling sites in the Kurunegala District. In this zone the mean value was 0.8 larvae.

In the dry zone, only two larvae were found in two paddy fields in the Polonnaruwa and Hambantota Districts and no larvae were detected in four other paddy fields, namely two sites in Anuradhapura in the northern district and two sites in Polonnaruwa in the northern district. Only 0.2 larvae were recorded on an average in this zone (Table 2).

Dry season: We could not find any predatory larvae at 12 sampling sites. Out of these, at 10 sites ratoon crops were present in the wet zone in 1990 (Table 1). In this season at the time of sampling, paddy fields with rice growing were not observed both in the intermediate and dry zones.

The differences in the population density among all the climatic zones could be compared in the Maha season. The results suggested that the predator density was relatively high in the wet zone (0.6 larvae) and the intermediate zone (0.8 larvae) compared with that in the dry zone (0.2 larvae) (Table 2). The same tendency was observed in the Yala season, namely the density was relatively higher in the wet zone (3.0 larvae) than in the intermediate zone (0.6 larvae).

These differences in distribution were also observed in the same district in each agroclimatic zone. For example, there were marked differences in the population density among sampling sites in the Gampaha District where the number of predatory larvae ranged from 1.9 to 12.2. The largest mean number of predatory larvae was 6.0 in the Yala season.

Based on the data of our short-term investigations the cause of differences in the distribution could not be determined. However, we assumed that the predator larvae aggregated in the paddy fields because they considered them as suitable habitats, due to the availability of prey. Several carabid species are known to aggregate in areas where prey are abundant[1].

The gall shows a hole only when the gall midge pupa bores an emerging hole near the tip of the gall. However, we often observed a hole at almost the same position as that of the emergence hole of the rice gall midge on the gall, together with a wounded or dead gall midge pupa and a larva of *O. indica* in the gall. The length of the hole which the predator bored was slightly longer than that of the gall midge emergence hole. These observations suggest that the predatory larvae detected the gall midge pupae in the galls and then they bore a hole to enter the gall to attack the gall midge pupae.

The predatory larvae cannot observe the gall midge pupae in the gall cavities directly, but seem to react to the moving shadow of the prey pupa. This can be seen through the thin wall of the gall when the pupa wriggles upwards from the bottom position to the uppermost position just before emergence. Thiele (1977) also reported that *Cicindela* larvae only react to moving objects in their prey-catching behavior[5].

We found predator pupae in the galls collected in the Kalutara District on 5 July 1989 in the first survey[3] and in the Kegalla District on 14 January 1992 in the third survey, respectively and the adults of *O. indica* emerged from these pupae. These facts indicate that the predators may pupate in the galls in the paddy field, although they usually pupate somewhere in the soil outside the paddy field.

Although Kobayashi, one of the authors carried out studies on the natural enemies of the rice gall midge in Thailand from 1973 to 1977, he could not find predator larvae as abundant as those in Sri Lanka. Therefore paddy fields in Sri Lanka or their surroundings seem to be suitable for the predators as habitats. These results suggest that further studies about the bionomics of the predator and feeding behavior are necessary to evaluate it as a natural enemy of the rice gall midge.

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