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SD Chaudhari
P.G. Scholars, Department of
Entomology, N. M. College of
Agriculture, Navsari
Agricultural University, Navsari,
Gujarat, India

HR Kachhela
P.G. Scholars, Department of
Entomology, N. M. College of
Agriculture, Navsari
Agricultural University, Navsari,
Gujarat, India

HD Zinzuvadiya
P.G. Scholars, Department of
Entomology, N. M. College of
Agriculture, Navsari
Agricultural University, Navsari,
Gujarat, India

Correspondence
SD Chaudhari
P.G. Scholars, Department of
Entomology, N. M. College of
Agriculture, Navsari
Agricultural University, Navsari,
Gujarat, India

Biology of rice sheath mite, *Steneotarsonemus spinki* Smiley on rice

SD Chaudhari, HR Kachhela and HD Zinzuvadiya

Abstract

The biology and morphometrics of *Steneotarsonemus spinki* Smiley on rice variety GR-11 was studied in laboratory condition at 31.1 ± 0.9 °C and 28.9 ± 0.6 °C maximum and minimum with 54.8 ± 15.18 per cent and 69.3 ± 11.4 per cent mean morning and evening relative humidity, respectively. The average biology of *S. spinki* showed that the egg, larval, quiescent and adult (male and female) periods were 1.875 ± 0.559 days, 3.575 ± 0.613 days, 0.556 ± 0.167 days, 3.75 ± 0.425 days and 5.00 ± 0.972 days, respectively. The pre-oviposition period, oviposition period and post-oviposition period were 1 to 2 days, 1.5 to 3 days and 1.5 to 2.5 days, respectively. Total life cycle of *S. spinki* male occupied 8.95 ± 0.864 days and female required 10.20 ± 0.856 days. Sex ratio of male: female was 1: 1.59.

Keywords: Biology, rice, *Steneotarsonemus spinki* Smiley

1. Introduction

Asia is considered to be “rice bowl” of world, where more than 90 per cent of world's rice is produced and consumed. It is one of the oldest and second most intensively grown cereal crops of the world next to wheat and rank third in grain production. The area covered under rice in the world is 161.16 million hectares with an average production of 478.69 million metric tonnes. India is an important centre of rice cultivation. India has the largest area of 44.11 million hectares with an annual production and productivity were 105.48 million metric tonnes and 2391 kg/ha, respectively [2]. The rice growing area of the Gujarat state covers the districts of Valsad, Navsari, Dang, Surat, Bharuch, Narmada, Vadodara, Kheda, Anand, Dahod and Panchmahals [6].

Insect pests represent a significant proportion of the overall reduction in rice production. Estimated loss due to insect pests is 55.12 million rupees annually in India [8]. The rice plant is subject to attack by more than 100 species of insects. Out of them 20 can cause economic damage. Different pests like stem borer, leaf folder, sheath mite, horned caterpillar, mites and gundhi bug causes significant damage to rice crop [16]. Among non insect pests the mites are now considered as significant pest of rice. In India 61 species of the mites are reported to be associated with rice production and storage [11].

Among mites, sheath mites (*Steneotarsonemus spinki* Smiley) which belong to family Tarsonemidae infests flag leaf sheath of rice causing brown discoloration. Infestation of this mite on panicle causes chaffy grains and also discoloration of filled or ill-filled grains [16]. Feeding of these mites on reproductive parts of flowers results in grain sterility [12]. Recently, in India this mite was observed to cause significant reduction in yield of rice crop in Gujarat and West Bengal [1]. Incidence of *S. spinki* was noticed first time in 1993 from paddy field in south Gujarat [9]. The occurrence of rice sheath mite has increase in south Gujarat since few years and has become major problem as it reduce quality & quantity of rice production. That way the study of sheath mite behavior present investigation was carried out during *kharif* 2016.

2. Materials and Methods

The study on biology of *Steneotarsonemus spinki* was carried out in the laboratory, Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari at 31.1 ± 0.9 °C and 28.9 ± 0.6 °C average of maximum and minimum laboratory temperature with 54.8 ± 15.18 per cent and 69.3 ± 11.4 per cent mean of morning and evening relative humidity, respectively.

2.1 Experimental details

Crop	: Rice
Variety	: GR-11
Season	: <i>kharif</i> 2016
Layout	: Pot culture
Location	: Department of Entomology, N. M. College of Agriculture, NAU, Navsari
Instrument used	: Stereo trinocular microscope olympus-SZ (16) fitted with Brand Catcam-130 camera, Thermometers (dry and wet bulb)

2.2 Observations

Incubation period, Larval period, Quiescent period, Adult period, Total life cycle, Pre-oviposition period, Oviposition period, Post-oviposition period, Fecundity, Sex ratio, Hatching percentage and length and width of all stages of sheath mite.

2.3 Method of observation

Maintenance of host plant and sheath mite culture on potted rice plant. Ten gravid females obtained from mass culture were released on a transversely cut leaf sheath pieces over moist cotton swab kept in petri dish by a fine camel hair brush employing a stereo binocular microscope in the morning hours. On next day, the leaves were carefully observed for eggs. Then the females were transferred to another set for egg laying. The eggs so obtained were used for details biological study of rice sheath mite. The old leaves were replaced periodically with new fresh leaves so as to ensure their good quality. Newly emerged larvae was transferred and released individually on fresh leaf sheaths. When matured larvae entered into quiescent stage, it was then transferred to new leaf sheath and kept under careful observations even at two hours interval for recording the length of its short period. On adult formation some specimens were observed critically both under stereo-binocular microscope and slide microscope for detailed morphological features. Other live specimens were separated as male and females, paired and released individually in pair on different leaves and observed again twice a day for starting of egg laying and pre oviposition period was noted. The gravid female was carefully picked up with fine camel hair brush and released on fresh rice leaf sheath at 24 hours interval to record daily egg laying and fecundity of female.

3. Results and Discussion

3.1 Egg

3.1.1 Site and pattern of oviposition

Eggs were laid by adult female in intracellular space of leaf sheaths of rice plant. The eggs laid either singly or in masses in small clusters and each cluster consist of 2 to 5 eggs. Patel and Purohit observed that eggs were laid singly or in cluster of 3 to 4 eggs in intracellular space of the rice leaf sheaths. The eggs were slightly stucked with the inner surface of leaf sheaths^[7]. The present result was in agreement with the past findings.

3.1.2 Colour and shape

Eggs were cloudy, creamy white, yellowish white and elongated. As time progressed, it turned more whitish. Similar observations were reported by Sogawa^[15] and Patel and Purohit^[7].

3.1.3 Size of eggs

Length and width of freshly laid eggs measured were $0.13 \pm$

0.005 mm and 0.071 ± 0.006 mm, respectively (Table 2). Patel and Purohit observed that *S. spinki* eggs were large measuring from 0.132 to 0.211 mm with an average of 0.164 ± 0.017 mm in length and from 0.092 to 0.132 mm with an average of 0.107 ± 0.011 mm in width^[7]. The previous observations were more or less in conformity with the present investigations.

3.1.4 Incubation period

The larva emerged out from the eggs by making a slit, the larva widened this opening by pushing apart with its legs and came out from egg shell. The incubation period of *S. spinki* ranged from 1 to 3 days with a mean of 1.875 ± 0.559 days (Table 1). Similarly, Chen *et al.* reported the egg stage lasting 1 to 5 days at 28 °C temperature^[3], which was closely tallies with the present findings.

3.1.5 Hatching percentage

Total ten sets of rice sheath mite, *S. spinki* were observed for hatching percentage. Hatching percentage ranged from 50 to 100 per cent in different slots. Total 168 eggs were observed under laboratory conditions. Out of 168 eggs, 122 eggs were hatched with an average hatching percentage of 72.61 per cent on rice variety GR-11 (Table 1).

3.2 Larva

Male and female larvae of rice sheath mite, *S. spinki* were differentiated on the basis of its size. The male larvae were comparatively smaller than female larvae.

3.2.1 Colour, shape and size

Larvae were transparent white in colour. Male larvae measured 0.155 ± 0.016 mm in length and 0.078 ± 0.004 mm in width where as female larvae measured 0.156 ± 0.017 mm and 0.069 ± 0.007 mm in width (Table 2). Patel and Purohit observed that male larvae were measuring on an average of 0.244 ± 0.014 mm in length and 0.107 ± 0.005 mm in width, as compared to female larvae measuring on an average 0.268 ± 0.011 mm in length and 0.081 ± 0.004 mm in width^[7]. Thus, the results obtained through present investigations are slightly differ from the earlier worker.

3.2.2 Larval period

The total larval development period of *S. spinki* varied from 2.5 to 4.5 days with an average of 3.575 ± 0.613 days (Table 1). As per the Gutierrez^[4] and Sogawa^[15] the larval period of *S. spinki* was 1 day. Earlier, larval period of *S. spinki* was recorded as 0.1 to 1.3 days with an average 0.7 ± 0.35 days on rice plant in laboratory by Tora Sanchez and Mesa Coba^[17] which was more or less tallies with the present findings. Patel and Purohit recorded that larval period of *S. spinki* ranged from 0.5 to 2.0 day with an average of 1.23 ± 0.0445 days for male and 0.4 to 2.0 day with an average of 1.52 ± 0.524 days for female^[7]. As considering the larval period, present findings were slightly differ from the research.

3.3 Quiescent stage

3.3.1 Colour, shape and size

The mature larva entered into a quiescent stage and feeding of the larva was restricted. Quiescent stage measured 0.212 ± 0.016 mm in length and 0.078 ± 0.012 mm in width (Table 2).

3.3.2 Quiescent period

Mites become inactive for some time in quiescent stage till

the adult emergence period of *S. spinki* was 0.5 to 1.0 day with an average 0.556 ± 0.167 day (Table 1). Gutierrez [4] and Sogawa [15] reported that quiescent period of *S. spinki* was 2 days. Whereas, Chen *et al.* reported it was 0.5 day and 0.25 day at 28 °C and 30 °C temperature, respectively [3] which supports the present findings.

3.4 Adult

3.4.1 Colour, shape and size

Male and female of *S. spinki* was almost transparent. Male of rice sheath mite was broader in length and have dagger shape setae. Female was narrower and slightly bigger than the male. The measurement of rice sheath mite, *S. spinki* revealed that the length and width of male were 0.203 ± 0.013 mm and 0.098 ± 0.012 mm (Table 2). In case of female adult length was 0.224 ± 0.016 mm, whereas the width was 0.072 ± 0.004 mm. Patel and Purohit reported that the adult male measured 0.237 to 0.289 mm in length and 0.132 to 0.171 mm in width. Whereas, females were narrower measuring 0.263 to 0.316 mm in length and 0.105 to 0.132 mm in width [7]. Thus, the present findings are quite differing to that of past research. This variation may be due to the different ecological condition.

3.4.2 Adult period

The data pertaining to adult period of male and female of *S. spinki* are presented in Table 1. The data showed that the longevity of male ranged from 3.0 to 4.5 days with an average of 3.75 ± 0.425 days. Longevity of female varied from 3.5 to 7.0 days with an average of 5.0 ± 0.972 days. Thus, the female lived longer than the male. Gutierrez reported that the longevity of male and female was 7 and 14 days, respectively at 25 °C temperature. Whereas longevity of male and female was 8 and 16 days, respectively at 28 °C temperature [4]. Patel and Purohit reported that longevity of male adult was 5 to 7 days and female longevity was 6 to 9 days [7]. However, Chen *et al.* reported that male and female adult longevity were 2 to 7 days and 3 to 8 days, respectively at 30 °C temperature [3]. Thus, past workers findings are more or less tally with the present findings.

3.5 Pre-oviposition, oviposition and post-oviposition period

The period between the emergence of an adult female and start of its egg laying is known as pre-oviposition period. Looking to the data (Table 1) it can be concluded that pre-oviposition period varied from 1 to 2 days with an average of 1.55 ± 0.369 days. Period of depositing eggs is called oviposition period. The oviposition period of *S. spinki* was ranged from 1.5 to 3.0 days with an average of 2.2 ± 0.675 days. The female did not die immediately after the

oviposition. After oviposition female lived for certain period is called as post-oviposition period. The post oviposition period was ranged from 1.5 to 2.5 days with an average of 1.8 ± 0.35 days which are in close concern to the findings of Patel and Purohit [7]. However, Santos *et al.* reported the pre-oviposition and oviposition period were 1.2 and 9.8 days, respectively [13]. Thus, oviposition period slightly differ to the present findings because of different experimental conditions.

3.6 Fecundity

Adults of *S. spinki* usually carried the quiescent female on its abdomen. The numbers of egg laid by individual female species during its life period is called fecundity. In laboratory, the egg laying capacity recorded during the study was varied from 07 to 29 eggs with an average of 16.8 ± 7.567 eggs per female (Table 1). Almost similar fecundity of 27.7 eggs per female was recorded by Santos *et al.* [13] while it was 20 eggs per female was recorded by Patel and Purohit [7]. Thus, present findings are conformity with past workers. According to Chen *et al.* fecundity was 78 eggs per female during its life span with an average of 30.34 eggs per female [3]. Lo and Ho reported that an average number of eggs laid by *S. spinki* was 59.5 per female [5]. The result of fecundity was more or less similar to the past works.

3.7 Sex ratio

Proportion of male and female emerged from eggs during hatching is called sex ratio. Based on ten sets of eggs taken during recording hatching percentage male to female ratio was calculated. The sex ratio of male to female was 1: 1.59. These result indicated that the proportion of male to female was more. Gutierrez recorded the sex ratio (male: female) 1: 4 in the field conditions [4]. Whereas Patel and Purohit recorded sex ratio of 1:1.5 under controlled conditions [7]. Thus, the results obtained through present investigations are in agreement with the past worker's findings.

3.8 Total life cycle

Total life cycle of *S. spinki* male and female was recorded an average of 8.95 ± 0.864 and 10.20 ± 0.856 days, respectively (Table 1). Ramos and Rodriguez observed that *S. spinki* required an average of 7.77 days for total developmental at 24.42 °C temperature [10]. Santos *et al.* observed that *S. spinki* completed its life in 11.33 days at 20 °C temperature and 4.88 days at 34 °C temperature [14]. Patel and Purohit stated that total life cycle for male ranged from 10.5 to 14.5 days with an average of 12.20 ± 1.47 days and it was 12.5 to 16.00 days with an average of 13.75 ± 1.17 days for female [7]. Thus, the result of the present research is more or less in agreement with the past workers.

Table 1: Total life cycle of rice sheath mite, *S. spinki* on rice (GR- 11)

Sr. No.	Developmental stages (days)	Duration in days		
		Min.	Max.	Av. \pm S. D.
1	Incubation period	1.0	3.0	1.875 ± 0.559
2	Larval period	2.5	4.5	3.575 ± 0.613
3	Quiescent period	0.5	1.0	0.556 ± 0.167
4	Adult			
	Male	3.0	4.5	3.75 ± 0.425
	Female	3.5	7.0	5.00 ± 0.972
5	Total life cycle			
	Male	7.5	10	8.95 ± 0.864
	Female	9.0	12	10.20 ± 0.856

6	Pre-oviposition period	1.0	2.0	1.55 ± 0.369
7	Oviposition period	1.5	3.0	2.2 ± 0.675
8	Post-oviposition period	1.5	2.5	1.8 ± 0.35
9	Fecundity	07	29	16.8 ± 7.567
10	Sex ratio	-	-	1: 1.59
11	Hatching percentage	50 %	100 %	72.61 %

Table 2: Morphometrics of rice sheath mite, *S. spinki* on rice (GR- 11)

Stages of <i>S. spinki</i>	Rice	
	Length (mm)	Width (mm)
	Av. ± S. D.	Av. ± S. D.
Eggs	0.13 ± 0.005	0.071 ± 0.006
Immature		
Male	0.155 ± 0.016	0.078 ± 0.004
Female	0.156 ± 0.017	0.069 ± 0.007
Quiescent	0.212 ± 0.016	0.078 ± 0.012
Adult		
Male	0.203 ± 0.013	0.098 ± 0.012
Female	0.024 ± 0.016	0.72 ± 0.004

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