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Biological Attributes of Rice Sheath Mite, *Steneotarsonemus spinki* Smiley on Alternate Hosts of Rice

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A B S T R A C T

The biology and morphometrics of *Steneotarsonemus spinki* Smiley on alternate hosts of rice: Jungle rice (*Echinochloa colonum* L.) and Nut grass (*Cyperus rotundus* L.) were studied in laboratory conditions. The average incubation period of *S. spinki* was 2.75 ± 0.679 days and 2.4 ± 0.476 days on *E. colonum* and *C. rotundus*, respectively. The total larval period of *S. spinki* was 2.5 ± 0.513 and 3.45 ± 0.626 days on *E. colonum* and *C. rotundus*. The quiescent period was 0.591 ± 0.202 day and 0.688 ± 0.372 day on *E. colonum* and *C. rotundus*, respectively. The male and female longevity of *S. spinki* was 3.15 ± 1.203 days and 4.05 ± 0.643 days on *E. colonum*, whereas it was 2.8 ± 0.715 days and 3.7 ± 0.888 days on *C. rotundus.* The pre-oviposition period was 1 to 2.5 days on *E. colonum* and *C. rotundus*. The oviposition periods of *S. spinki* varied from 0.5 to 2.5 days and 1 to 2 days on *E. colonum* and *C. rotundus*, respectively. The post oviposition period of *S. spinki* was 1 to 2 on *E. colonum* and *C. rotundus.* Total life cycle of *S. spinki* male occupied 8.70 ± 1.316 days and 8.95 ± 1.342 days in case of *E. colonum* and *C. rotundus.* Female required 9.60 ± 1.486 days and 9.85 ± 1.313 days on *E. colonum* and *C. rotundus*, respectively.

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 (Anonymous, 2014-15). Gujarat is an important rice growing state of the India which occupies an area of 0.786 million hectares producing 1.830 million tonnes with an average productivity of 2329 kg/ha (Anonymous, 2014-15).

Among the pests, 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 (Srinivasa *et al.,* 2004). Feeding of these mites on reproductive parts of flowers results in grain sterility (Rao *et al.,* 2000). There were many alternate hosts on which *S. spinki* continue their development and growth that affect the rice crop later. Rao and Prakash (2002) reported a weed, *Schoenoplectus articulatus* (Cyperaceae) as an alternate host of *S. spinki* during the field surveys at CRRI, Cuttack, and Orissa. Khimji (2005) observed that *S. spinki* survived on two graminaceous weed plants *viz., Cyprus difformis* and *Cynodon dactylon* and on post-harvest remain of rice crops during off season and served as source of infestation for next *kharif* season. Srinivasa and Prabhakara (2007) reported that eggs and active stages of *S. spinki* were noticed on leaves of other graminaceous weeds *Cyanodon dactylon* and *Echinochloa* sp. and collected the sample from the vicinity of the rice fields in Karnataka. Chandrasena *et al.,* (2016) in Sri Lanka, observed that *Sacciolepis interrupta* act as an alternate host of the *S. spinki*, while *Echinochloa crus-galli* and *Leptochloa chinensis* play minor role. Recently, in India this mite was observed to cause significant reduction in yield of rice crop in Gujarat and West Bengal (Anonymous, 2007-09). Incidence of *S. spinki* was noticed first time in 1993 from paddy field in south Gujarat (Rai *et al.,* 1998). The occurrence of rice sheath mite has increase in south Gujarat since few years and has become major problem in rice cultivation as it reduce quality and quantity of rice production. So that the study of sheath mite behavior present investigation was carried out during *kharif* 2016.

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 ºC and 28.9 ± 0.6 ºC 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.

Maintenance of sheath mite culture

Stock culture of rice sheath mite, *S. spinki* Smiley was maintained both on rice leaf sheath and rice grown in pots. Initially severely infested leaves with rice sheath mite, *S. spinki* Smiley collected from rice field of Main Rice Research Centre, N.A.U., Navsari and surrounding fields were stapled on potted rice plants for mass multiplication of sheath mites during *kharif* 2016.

Alternate hosts

Rice sheath mite, *S. spinki* which infest first on rice crop. Some weeds of graminae family are the alternate hosts of rice sheath mite. Hence, graminaceous weeds in the fields as well as surrounding area were observed and bring the infected weeds to the laboratory for study the biology of *S. spinki* on it, according to methodology mention for the rice.

Method of observation

A stereo binocular microscope was used for critical observations on behavior, colour, morphology and other attributes of the mite in different stages. Laboratory temperature (minimum and maximum) and relative humidity (morning and evening) were recorded daily by using dry and wet bulb thermometer during the period of study. A stereo trinocular microscope olympus-SZ (16) fitted with Brand Catcam-130 camera having software power Scopephoto was used for measuring the size of various stages of rice sheath mite.

Before using the leaf for different experiments, the healthy green leaves selected from potted plants were thoroughly washed with tap water, dried it and examined under stereo binocular microscope to remove or kill any insect or mite stages found on them. 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 with the help of fine camel hair brush under stereo binocular microscope. The eggs so obtained were used for details biological study of rice sheath mite. The cotton swabs were kept saturated with water from time to time. So that the leaves may remain in fresh condition for longer time. 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 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 carefully picked up with fine camel hair brush and released on fresh leaf at 24 hours interval to record daily egg laying and fecundity of female. The post oviposition period was also recorded. The longevity of male and female were recorded separately by rearing individuals in each category. Total life cycle from egg to adult and sex ratio was recorded in laboratory conditions.

Results and Discussion

The study on biology of Rice sheath mite, *Steneotarsonemus spinki* was carried out in the laboratory during *kharif* 2016. Looking to the infestation of *S. spinki* on rice crop and its associated weeds, we have taken two weeds. They were Jungle rice (*Echinochloa colonum* L.) and Nut grass (*Cyperus rotundus* L.) as alternate host for studying the biology.

Eggs were laid by adult female in intracellular space of leaf and on the leaf in laboratory condition. The eggs laid either singly or in masses in small clusters and each cluster consist of 2 to 5 eggs. The eggs were slightly sticked with the inner surface of leaf sheaths. Eggs were cloudy, creamy white, yellowish white and elongated. As time progressed, it turned more whitish. Eggs of *S. spinki* measured 0.12 to 0.14 mm in length and 0.132 ± 0.006 mm in width and 0.137 ± 0.007 mm in length and 0.075 ± 0.007 mm in width on *E. Colonum* and *C. rotundus*, respectively (Table 2). The average incubation period of *S. spinki* was 2.75 ± 0.679 days and 2.4 ± 0.476 days on *E. colonum* and *C. rotundus*, respectively. Total hatching percentage of *S. spinki* was recorded 71.05 per cent and 67.71 per cent on *E. colonum* and *C. rotundus*, respectively (Table 1).

The newly hatched larvae of rice sheath mite, *S. spinki* were opaque and white in colour. Male larvae of *S. spinki* measured 0.147 ± 0.009 mm in length and 0.08 ± 0.008 mm in width. Female larvae measured 0.175 ± 0.016 mm in length and 0.074 ± 0.005 mm in width on *E. colonum*. Whereas on *C. rotundus*, length of male larvae measured 0.145 ± 0.011 mm and width measured with an average of 0.081 ± 0.007 mm.

Table.1 Total life cycle of rice sheath mite, *S. spinki* on alternate hosts of rice

Sr. No.	Developmental stages of *S. spinki*	Duration in days					
		E. colonum			*C. rotundus*		
		Min.	Max.	Av. ± S. D.	Min.	Max.	Av. ± S. D.
1	**Incubation period**	1.5	3.5	2.75 ± 0.679	1.5	3.0	2.40 ± 0.476
2	**Larval period**	1.5	3.0	2.50 ± 0.513	2.5	4.5	3.45 ± 0.626
3	**Quiescent period**	0.5	1.0	0.591 ± 0.202	0.5	1.5	0.688 ± 0.372
4	**Adult**						
	Male	1.0	5.0	3.15 ± 1.203	1.5	4.0	2.8 ± 0.715
	Female	3.0	5.0	4.05 ± 0.643	2.0	5.0	3.7 ± 0.888
5	**Total life cycle**						
	Male	7.0	11	8.70 ± 1.316	7.0	11.5	8.95 ± 1.342
	Female	7.5	12.5	9.60 ± 1.486	8.0	12	9.85 ± 1.313
6	**Pre-oviposition period**	1.0	2.5	1.55 ± 0.369	1.0	2.5	1.6 ± 0.459
7	**Oviposition period**	0.5	2.5	1.6 ± 0.516	1.0	2.0	1.5 ± 0.408
8	**Post-oviposition period**	1.0	2.0	1.45 ± 0.369	1.0	2.0	1.55 ± 0.369
9	**Fecundity**	10	22	15.2 ± 3.736	05	20	12.7 ± 5.250
10	**Sex ratio**	-	-	1: 1.45	-	-	1: 1.38
11	**Hatching percentage (%)**	44.45	100	71.05	40	83.34	67.71

Table.2 Morphometrics of rice sheath mite, *S. spinki* on alternate hosts of rice

Stages of *S. spinki*	*E. colonum*		*C. rotundus*	
	Length (mm)	**Width (mm)**	**Length (mm)**	**Width (mm)**
	Av. ± S. D.	Av. ± S. D.	Av. ± S. D.	Av. ± S. D.
Eggs	0.132 ± 0.006	0.069 ± 0.006	0.137 ± 0.007	0.075 ± 0.007
Immature:				
Male	0.147 ± 0.009	0.08 ± 0.008	0.145 ± 0.011	0.081 ± 0.007
Female	0.175 ± 0.016	0.074 ± 0.005	0.158 ± 0.015	0.072 ± 0.004
Quiescent	0.22 ± 0.025	0.076 ± 0.008	0.22 ± 0.31	0.076 ± 0.008
Adult:				
Male	0.076 ± 0.008	0.202 ± 0.02	0.197 ± 0.022	0.098 ± 0.004
Female	0.232 ± 0.02	0.071 ± 0.009	0.235 ± 0.016	0.075 ± 0.01

Female larvae measuring 0.158 ± 0.015 mm in length and 0.072 ± 0.004 mm in width (Table 2). The total larval period of *S. spinki* was 2.5 ± 0.513 and 3.45 ± 0.626 days on *E. colonum* and *C. rotundus*, respectively which was quite similar to each other (Table 1).

The mature larvae entered into a quiescent stage and feeding of the larvae was restricted. Quiescent stage of *S. spinki* measured 0.22 ± 0.025 mm length and 0.076 ± 0.008 mm width and 0.22 ± 0.31 mm in length and 0.076 ± 0.008 mm in width on *E. Colonum* and *C. rotundus*, respectively. During this period, the mite suspended all its activity of feeding. The quiescent period of *S. spinki* observed rarely and it was almost equal on *E. colonum* and *C. rotundus.* The quiescent period was 0.591 ± 0.202 day and 0.688 ± 0.372 day on *E. colonum* and *C. rotundus* (Table 1).

Male and female of *S. spinki* were transparent white in colour. Male was shorter in length and broader in width as compare to female. Male of *S. spinki* measured 0.076 ± 0.008 mm in length and 0.202 ± 0.02 mm in width and 0.197 ± 0.022 mm in length and 0.098 ± 0.004 mm in width on *E. Colonum* and *C. rotundus*, respectively. Female of *S. spinki* measured 0.232 ± 0.02 mm in length and 0.071 ± 0.009 mm in width and 0.235 ± 0.016 mm in length and 0.075 ± 0.01 mm in width on *E. Colonum* and *C. rotundus*, respectively (Table 2). The male and female longevity of *S. spinki* was 3.15 ± 1.203 days and 4.05 ± 0.643 days on *E. colonum.* The male and female longevity of *S. spinki* was 2.8 ± 0.715 days and 3.7 ± 0.888 days on *C. rotundus* (Table 1).

The pre-oviposition period was 1 to 2.5 days on *E. colonum* and *C. rotundus*. The oviposition periods of *S. spinki* varied from 0.5 to 2.5 days and 1 to 2 days on *E. colonum* and *C. rotundus*, respectively. The post oviposition period of *S. spinki* varied from 1 to 2 on *E. colonum* and *C. rotundus*. Total fecundity of *S. spinki* was found to be 15.2 ± 3.736 eggs/female and 12.7 ± 5.25 eggs/female on *E. colonum* and *C. rotundus*, respectively. When rice sheath mites, *S. spinki* reared on *E. colonum* and *C. rotundus* sex ratio of male to female were 1:1.45 and 1:1.38 (Table 1).

In case of *E. colonum*, total life cycle for *S. spinki* male was 8.70 ± 1.316 days and 9.60 ± 1.486 days for female. *S. spinki* male completed its life cycle in 8.95 ± 1.342 days and female required 9.85 ± 1.313 days on *C. rotundus* (Table 1).

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