

Biology of rice sheath mite, *Steneotarsonemus spinki* Smiley

K. A. Patel* and M. S. Purohit

Department of Agricultural Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari – 396450, Gujarat, India

ABSTRACT

Biology of the rice tarsonemid mite *Steneotarsonemus spinki* was studied under laboratory at $28 \pm 2.1^\circ\text{C}$ temperature and 88 ± 5.9 per cent relative humidity during September 2003. Both the sexes passed through three stages viz. egg, larva, and adult and a short resting period known as quiescent stage. The egg stage lasted on an average 3.32 ± 0.55 days. Average larval period for male was 1.23 ± 0.44 and for female 1.52 ± 0.52 days and quiescent period was 0.53 ± 0.22 day for male and 0.66 ± 0.24 day for female. Adult period was 5.28 ± 0.54 days for male and 6.68 ± 0.98 days for female. The total life cycle was completed in 12.20 ± 1.47 days and 13.75 ± 1.17 days for male and female, respectively. The pre-oviposition, oviposition and post-oviposition periods were 1.40 ± 0.39 , 4.50 ± 1.20 and 1.65 ± 0.47 days, respectively. The female laid average 20 ± 5.03 eggs during its life span. The sex ratio (female: male) was recorded 1:1.5 and 1:2.8 in laboratory and field conditions, respectively.

Key words: rice, sheath mite, *Steneotarsonemus spinki*, biology

South Gujarat is an important rice growing tract of the state covering 2.3 lakh hectares area under cultivation which accounts for 34.63 per cent of the total rice growing area of the state. It contributes about 40 per cent of the state rice production with an average productivity of 1600 kg ha^{-1} (Anon., 2002).

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 (Puri *et al.*, 1999). 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 (Rao *et al.*, 1999).

The rice sheath mite, *Steneotarsonemus spinki* Smiley, which belongs to the family tarsonemidae, has been reported from Taiwan (Chen *et al.*, 1979), Cuba (Ramos and Rodriguez, 1998), Philippines (Sogawa, 1977) and Madagascar (Gutierrez, 1967). In India, it has been reported from Orissa (Rao and Das 1997). East and West Godavari districts of Andhra Pradesh (Rao *et al.*, 2000).

Tarsonemid mites directly or indirectly causes considerable amount of quantitative and qualitative losses in rice production. Phytophagous tarsonemid mites like *Steneotarsonemus spinki* and *Tarsonemus cuttacki* (Isvari) known to damage parachymatous tissues of rice plant and reduce the amount of nutrients to the developing grains resulting in reduction of the grain weight and size. Feeding of these mites on reproductive parts of rice flowers results in grain sterility (Rao *et al.*, 1999). These mites have also been reported as vector/carrier of pathogenic fungi like *Acrocyldrium (Sarocladium) oryzae*, *Fusarium moniliformae*, and *Helminthosporium oryzae* (Rao *et al.*, 1999).

Incidence of *S. spinki* was noticed first time in 1993 from paddy fields in South Gujarat (Rai *et al.*, 1998). Subsequent survey carried out in the area, revealed that the incidence of rice sheath mite gradually increased and damage reached to severe pest status. In a effort to carry out further investigation on this rice sheath mite study on biology of *S. spinki* was undertaken under South Gujarat condition.

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 26 to 31°C (average 29°C) temperature and 71 to 90 per cent RH (average 88 % RH) during September 2003.

Stock culture of *S. spinki* was raised and maintained on the rice plants (cv. Jaya) grown in the polythene bags. For the purpose, leaf sheaths heavily infested with *S. spinki* were collected from NAU, Farm and brought to the laboratory. Infested leaf sheath was carefully opened from the upper end under stereo binocular microscope and the piece of the opened leaf sheath with gravid females retained and kept near the base of the leaf sheath of rice plants raised in polythene bags. The disturbed gravid female from the piece migrated and settled inside the leaf sheath of plants and started laying eggs and mass rearing was accomplished under laboratory on potted plants.

Ten gravid females obtained from mass culture were released on a transversely cut leaf sheath pieces (10-15 mm) by a fine camel hair brush employing a stereo binocular microscope in the morning at 8.00 hours and on next day the leaf sheath was carefully opened with the aid of needle and the females were picked up and transferred to another set for egg laying with the help of fine camel hair brush employing a stereo binocular microscope. The egg laying so obtained was used for detail biology of *S. spinki* as under.

A stereo binocular microscope at magnification of 2.5X1.6 was used for critical observations on behaviour, colour, morphology etc. of the mite in different stages. A standard ocular micrometer fitted to stereo binocular microscope was used for measuring the size of various stages of *S. spinki*. Daily records of laboratory temperatures and relative humidity were recorded once a day using dry and wet bulb thermometer during the period of study.

The eggs so obtained during mass culture were observed twice a day (8.00 AM and 4.00 PM) carefully under stereo binocular microscope by gently opening the leaf sheath cover for their hatching. Newly emerged larvae were transferred and released individually inside the intra cellular space in cut sections of leaf sheath by

carefully lifting the one end of leaf sheath with help of needle. The cut sections of leaf sheath were kept turgid in Petri dish. In rare occasion larvae died before completing the life cycle while transferring. When matured larvae entered into quiescent stage, they were transferred to new cut sections of leaf sheaths and kept under careful observations at even 4 hours 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 in different cut sections of leaf sheaths in intracellular space and observed again twice a day for starting of egg laying and pre oviposition period. The gravid female then, carefully picked up with fine camel hair brush and released into intracellular space of fresh cut sections at even 24 hours interval to record day wise egg laying and total fecundity. The post oviposition period was also recorded. The longevity of mated and unmated male and female were recorded separately by rearing individuals in each category. Total life cycle from egg to adult was also recorded. Sex ratio was also recorded in laboratory as well as in the field conditions.

RESULTS AND DISCUSSION

The eggs were laid singly or in cluster of 3 to 4 eggs in intracellular space of the leaf sheaths. The eggs were slightly stucked with the inner surface of leaf sheaths. They were creamy white, opaque and elongated. The eggs were large, measuring from 0.132 to 0.211mm 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. After 48 hours eggs turned yellowish white and under high magnification, the embryo is clearly visible through the transparent egg shell. On eclosion, the tiny larva from the upper end of the egg crawled by first loosened the egg's anterior margin at mid dorsal line with the help of chelicerae and pedipalp and later with first two pairs of leg. It stretched to upper surface of egg cell and then appressing the body through anterior two legs on substrate. Remaining two pairs of legs and body had been stretched against the gravity to pullout the whole body. It took 15 minutes for the complete eclosion process. The incubation period ranged from 2 to 4 days with an average of 3.32 ± 0.557 days

Table 1. Duration of various stages of *Steneotarsonemus pinki*

Stage	Number observed	Duration in days		
		Min.	Max.	Av. \pm S.D.
Incubation	50	2.00	4.00	3.32 \pm 0.557
Larva (Male)	20	0.50	2.00	1.23 \pm 0.445
Larva (Female)	15	0.40	2.00	1.52 \pm 0.524
Quiescent Male	20	0.50	1.00	0.532 \pm 0.201
Quiescent (Female)	15	0.50	1.00	0.660 \pm 0.248
Adult (Male)	20	5.00	7.00	5.28 \pm 0.542
Adult (Female)	15	6.00	9.00	6.68 \pm 0.988
Pre-oviposition	10	1.00	2.00	1.40 \pm 0.392
Oviposition	10	3.00	6.50	4.50 \pm 1.20
Post-oviposition	10	1.00	2.50	1.65 \pm 0.474
Total life cycle (Male)	10	10.5	14.5	12.20 \pm 1.47
Total life cycle (Female)	10	12.5	16.00	13.75 \pm 1.17

Min. = Minimum, Max. = Maximum, Av. = Average, S.D. = Standard deviation

(Table 1).

The shape, size, colour and pattern of egg laying recorded under the study were more or less similar to finding of Sogawa (1997). Similarly, Chen *et al.* (1979) reported the egg stage lasting 1.5 to 4 days at 28°C temperature, which closely tallies with the present findings.

The newly hatched six legged larvae were opaque white in colour. The male and female larvae could be distinguished by their size. The larvae soon after emergence from eggs remained sluggish for 5-10 minutes at rest and started feeding and became active. The male larvae were measuring 0.211 to 0.289 (av. 0.244 \pm 0.014) mm in length and 0.105 to 0.132 (Av. 0.107 \pm 0.005) mm in width, as compared to female larvae measuring 0.237 to 0.289 (Av. 0.268 \pm 0.011) mm in length and 0.079 to 0.092 (Av. 0.081 \pm 0.004) mm in width. The body of male larvae is elongated and smaller in length as compared to female larvae, whereas it is broader than female larvae. The larval period ranged from 0.5 to 2.0 day (av. 1.23 \pm 0.0445 days) for male and 0.4 to 2.0 day (av. 1.52 \pm 0.524 days) for female. (Table 1).

The mature larvae entered into a quiescent stage and remained motionless until adult emergence. During this period, the mite suspended all its activity of feeding. The males emerged earlier as in this stage it

took 0.5 to 1.0 day with an average of 0.532 \pm 0.201 day, while the female quiescent stage lasted for 0.50 to 1.0 day with an average of 0.660 \pm 0.248 day. Earlier, Chen *et al.* (1979) reported it to be 1.0 and 0.5 day as at 25°C and 28°C temperature, respectively. Whereas, as per Sogawa (1977) quiescent period was 2 days. The quiescent stage developed in to adult male or female having four pairs of legs. The adults were creamy white in colour.

The observations under microscope revealed that the male had a short, stout, blunt spur like setae on tibia III, while a pair of dagger shaped setae was conspicuous on femur and genu IV. Further, the ventral propodosomal and hysterosomal setae sub-equal in length, coxae I with single pair of setae, slightly shorter than single pair on coxae II, coxae III with two pairs of setae sub equal in length and slightly longer than setae of coxae I and II. Coxae IV with pair of dagger shape setae. Legs I and II more or less similar in size and length, leg III longest, with spur like setae stouter and longer than spur like setae of leg I and II. Leg IV has femur with large inner median lateral flange and genu with dagger like ventral setae similar to that of femur. Tibia-tarsus short and stunt with ventrally curved claw. The males were broad and elliptical in shape. Whereas, leg III of female with fused and genu and without claw/empodia. Leg IV attenuated with segmented and ends into a pair of whip like setae.

The adult males were shorter in length and broader in width compared to female adults. Male measured 0.237 to 0.289 mm (Av. 0.273 \pm 0.014) mm in length and 0.132 to 0.171 mm (Av. 0.155 \pm 0.009) in width. Whereas, females were narrower measuring 0.263 to 0.316 mm (Av. 0.288 \pm 0.015) in length and 0.105 to 0.132 mm (Av. 0.107 \pm 0.007) in width. Male adult's longevity varied from 5 to 7 days with an average of 5.28 \pm 0.542 days, whereas female adults lived from 6 to 9 days with an average of 6.68 \pm 0.988 days. Thus female lived longer than male.

Chen *et al.* (1979) reported duration of male 4 to 14 days and female 7 to 15 days at 28°C temperature which is in proximity with present findings. However, Sogawa (1977) reported male and female adults longevity as 7-8 days and 14-16 days respectively at 25-28°C. This is not confirming to the present findings, might be due to different experimental conditions.

Adult males were generally seen congregating near quiescent females. They usually carried the quiescent female on its abdomen that was near to emergence as an adult. This phenomenon of carriage of female by male, known as precopulation lasted for 15 to 30 minutes. True copulation took place as soon as female adults emerged.

The female after emergence laid eggs after a lapse of certain time, this period was mentioned as pre-oviposition period. Pre oviposition period was varied from 1 to 2 days (av. 1.40 ± 0.392 days). The period of egg laying *i.e.* after the pre-oviposition till the termination of egg laying considered as oviposition period. The oviposition period of *S. spinki* was ranged from 3 to 6.5 days (av. 4.50 ± 1.20 days). The period between last egg laid and death of the adult female individual was considered as post-oviposition period. The post oviposition period ranged from 1 to 2.5 days (av. 1.65 ± 0.474 days). Chen *et al.* (1979) reported pre-oviposition and oviposition period as 1.5 to 4.0 days (av. 2.00 ± 0.1 days) and 5.5 to 11.0 days (av. 7.00 ± 0.4 days) at 28°C temperature, respectively.

The female laid 4 to 7 eggs per day with an average of 4.8 eggs per day. The fecundity per female varied from 15 to 32 eggs with an average of 20.00 ± 5.03 eggs. Hsiung Tseng (1979) reported that average number of eggs by a single female produced during its life span was 23.04, 48.05 and 18.03 at 25, 28 and 30°C temperature, respectively. As per Chen *et al.* (1979), a single female could lay up to 78 eggs during its life span with an average of 30.34 eggs. Lo and Ho (1979) reported an average number of eggs laid by *S. spinki* as 59.5/female.

Sex ratio (female: male) of *S. spinki* was calculated from the adults emerged from the culture reared in the laboratory as well as from the field collected adults. The sex ratio (female: male) was 1:1.5 in laboratory conditions, while 1:2.8 in field conditions. Gutierrez (1967) recorded the sex ratio (female: male) 4:1 in the field conditions in the month of January. Whereas Lo and Ho (1977) recorded sex ratio of 1:1 at 20°C temperature under controlled conditions. The present findings do not tally with the above reports. This variation in sex ratio might be due to different climatic conditions.

Total life cycle for male (egg to adult) 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 with an average of 13.75 ± 1.17 days, for female. Zhang and Pan (1983) in Taiwan reported the egg to adult period as 3 days at 30°C and 20 or more days at 20°C temperature in laboratory conditions. The present study was on biology was made at 28°C temperature.

ACKNOWLEDGEMENT

The authors express their gratitude to Director of Research, Navsari Agricultural University, Navsari – 396 450 (Gujarat) India for providing necessary facilities during the present investigation.

REFERENCES

- Anonymous 2002. Area and production of important food and non food crops in Gujarat State. Directorate of Agriculture, Gujarat State, Ahmedabad.
- Chen CN, Cheng CC and Hsiao KC 1979. Bionomics of *Steneotarsonemus spinki*, Smiley attacking rice plant in Taiwan. Recent Advances in Acarology. Academic Press, New York, U.S.A. Vol.1:111-117
- Gutierrez J 1967. *Steneotarsonemus madecassus* n.sp. agent d'une deformation des panicles de riz a Madagascar (Acarina: Tarsonemidae). *Bull. Ent. Soc. France*, 72 : 323-330
- Hsiung Tseng 1979. Mites associated with weeds, paddy and upland rice fields in Taiwan. *Acarology* 6 (2):770-780
- Lo KC and Ho CC 1977. Studies on rice tarsonemid mite, *Steneotarsonemus spinki* Smiley (Acarina: Tarsonemidae) National Sci. Council, 5 (4) : 274-284
- Pathak AR 1996. "Rice Smaranika". Main Rice Research Station, Gujarat Agricultural University, Navagam
- Puri SN, Murthy KS and Sharma OP 1999. Pest problems in India, current status. *Indian J Plant Prot*, 1-2 : 20-31
- Rai AB, Patel JR, Desai HR and Patel AJ 1998. Plant mites of agricultural importance in Gujarat. In: National Seminar on Entomology in 21st Century organized by Entomological Society of India at Rajasthan College of Agriculture, Udaipur (Rajasthan) from April 30 to May 2
- Ramos M and Rodriguez H 1998. *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae). New report for Cuba. *Revista-de-protection-vegetal.*, 13 : 25-28.

- Rao YS and Das PK 1977. A new mite pest of rice in India. Internl. Rice Res. Newsl, 2 : 8
- Rao J and Prakash A 1992. Infestation of tarsonemid mite *Steneotarsonemus spinki* Smiley in rice in Orissa. J Appl Zool Res, 3 : 103
- Rao J, Prakash A and Ghosh SK 1999. "Mites in rice ecosystem". Pub. Applied Zoolists Research association, Div.of Entomology, CRRI, Cuttack, India, pp.98
- Rao PRM, Bhavani B, Rao TRM and Reddy PR 2000. Spikelet sterility/grain discoloration in rice in Andhra Pradesh, India. Intl.Rice Res. Notes., 25 : 40
- Sogawa K 1977. Occurrence of the rice tarsonemid mites at IRRI, Philippines. Intern. Rice Res. Newsl., 2 (5) : 17
- Zhang BD and Pan ZH 1983. Preliminary observations on the biological characteristics of *Steneotarsonemus spinki*. Insect Knowledge, 18 (2) : 55-56