BIOLOGY OF RICE LEAF MITE, *Oligonychus oryzae* HIRST ON POPULAR RICE VARIETIES OF TAMIL NADU AT DIFFERENT TEMPERATURE REGIMES

VINOTH KUMAR, S, K. RAMARAJU

Abstract: An experiment was carried out on the biology of rice leaf mite, *Oligonychus oryzae* Hirst (Acari: Tetranychidae) to explore the developmental duration on three popular rice varieties (Co RH 4, Co 43 and Co (R) 50) of Tamil Nadu at different temperature regimes during 2014 to 2015. The study revealed that when the temperature increase, total duration of rice leaf mite was drastically reduced and increasing the number of life cycle. On account of three popular rice varieties Co 43 shows the total developmental duration (5.7±1.52) as highly susceptible whereas Co (R) 50 recorded (9.6±0.55) as highly resistant one and Co RH 4 shows moderately resistant at highest temperature of 35°C. These study will be useful to find out and forecasting which stage and temperature influencing the yield reduction and population growth.

Keywords: *Oryza sativa* L, Leaf mite, development duration, *Oligonychus oryzae* Hirst, Temperature and Relative Humidity (RH)

1. Introduction: Rice (*Oryza sativa* Linnaeus) is an important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population. This is the staple food of the people living in the eastern and the southern parts of the country. There are about 10,000 varieties of rice in the world out of which about 4,000 are grown in India. It accounts for about 52 per cent of the total food grain production and 55 per cent of the total cereal production in India. The total land area under rice in India is about 43.95 million hectare, production is 106.54 Million tones and per cent coverage under irrigation is 58.7. Tamil Nadu one of the leading rice growing states in India, has been cultivating rice from time immemorial as this State is endowed with all favourable climatic conditions suitable for rice growing. The total land area under rice in Tamil Nadu is about 22 lakh hectares with an annual production of 5.5million tones during the year 2013 – 14 (Indiastat, 2015).

Most important staple crop is threatened by various pests and diseases, in that the role of arthropod pests is very vulnerable for reducing the yield of rice. Among the arthropod pests, insects considered as major pest group threatening rice production. In recent years, mites have become negatively influencing the production of rice in India, particularly south India. Among the mites, *Oligonychus oryzae* Hirst (Acari: Tetranychidae) is the predominant species. *Oligonychus senegalensis* Gutierrez and Etienne is the most abundant leaf mite on rice in Senegal [6]. *Oligonychus pratensis* also feeds on rice, maize, sugarcane, sorghum and wheat [7]. Mites of the genus *Oligonychus* are well known as grass feeders [2]. *Oligonychus oryzae* was noticed from south India [4] and reported this mite as a serious pest, causing considerable loss, but reported its incidence as sporadic [11]. Occurrence, damage, bio ecology, varietal screening and management aspects of this mite have been studied in various geographical regions of India [5, 9, 10, 12 and 13].

In Tamil Nadu State, rice grown throughout all the districts, rice leaf mite occurs throughout the year and causes moderate to severe damage in different seasons in the recent years. The prolonged drought, seasonal changes, rainfall failure, increased temperature and humidity, indiscriminate use of acaricides and poor management practice are the key factors for the severe incidence of this mite species in Tamil Nadu. Hence, the present investigation were taken up to find out the impact of temperature on popular varieties of rice against rice mite and in order to come out with reliable and radical scientific data that are essential to know the vulnerable stages in biology to manage the pest effectively.

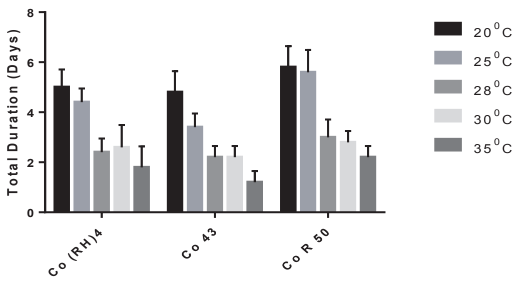
2. Material and methods:

2.1 Mass culturing: Rice seedlings were grown on small mud pots and placed inside the glass chamber under screen house condition. Mites were collected initially from the rice field and released on rice plant (30 days old) for getting healthy and homogenous culture. The gravid female were collected from pot culture and used for biological studies. The rearing was done at 25±5°C and 75±5% RH

2.2 Biology: An experiment was conducted at five different temperature (20, 25, 28, 30 and 35°C) and 75±5% RH, to study the biology of *O.oryzae* on three different popular rice varieties (Co RH 4, Co 43 and Co (R) 50) at the Acarology laboratory of Tamil Nadu Agricultural University (TNAU). The rice seedlings were raised in small plastic cups and placed into the Environmental chamber (model: NK systems – Biotron LPH 300). Five gravid females were released in each seedling at three leaf stage for egg laying and as soon as enough eggs were laid all females were removed. Thirty unhatched eggs were maintained in each seedling for observation. There were five replications. Observations were made every 6 hours using 10X hand lens until all mites reached adulthood. Observations on per cent egg hatching, developmental periods and adult longevity were recorded. Data were subjected to a one way analysis of variance and LSD was employed to separate the treatment means.

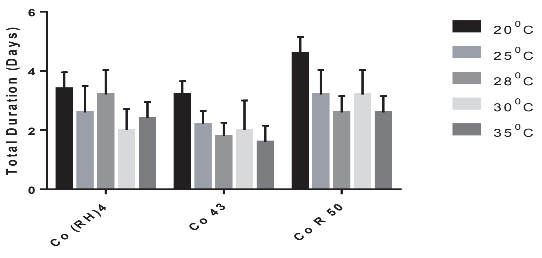
3. Results and Discussion: Eggs of *O. oryzae* were minute, spherical or globular in shape and pale whitish-yellow. Eggs were deposited on the lower surface of the leaves. Freshly laid eggs were colourless or clear and later turned pale yellow. The newly hatched larva was white with four dark spots. The adult females were light grayish-brown with four prominent dark black spots on the dorsal side; Males were small in size and slightly pinkish.

The incubation periods were significantly different among the temperatures and varieties tested. The longest incubation period was 5.8 ±0.84 days observed in Co (R) 50 whereas 5 + 0.71, 4.8 +0. 84 days recorded in Co (RH) 4 and Co 43 respectively at 20 °C (Table 1, 2 and 3), where, only 2.2±0.45 and 1.2±0.45 days were required at 30 and 35 °C, respectively for Co 43 (Table 2).



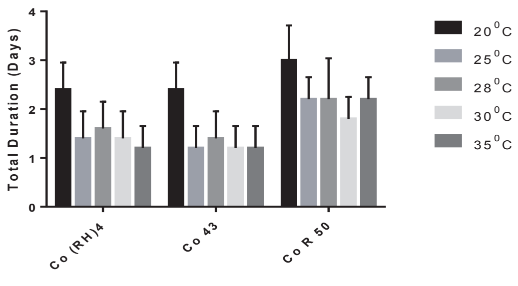
a. Egg

Depending on temperature 3.4 – 4.6 days the larvae were active prior to entering Protonymph (Table 1, 2 and 3). There was a significant difference in larval development times at 20, 25 and 35 °C but no significant difference was detected between 28 and 30 °C. Among three different varieties the highest larval period (4.6 ±0.55 and 2.6±0.55 days) was observed on Co (R) 50 at 20 and 35 °C respectively (Table 3), whereas minimum of 3.2 +0.45 and 1.6±0.55 recorded on Co 43 at 20 - 35 °C respectively (Table 2).



b. Larva

The protonymph lasted 1.2 – 3.0 days (Table 1, 2 and 3). The development time of protonymph decreased significantly with increasing temperature, whereas slightly increased (2.2±0.45 days) in Co (R) 50 at 35°C. Deutonymph period (3.8 – 1.6, 3.6 – 1.4 and 4.0 - 2.6 days) for Co RH 4, Co 43 and Co (R) 50 respectively at 20 –



c. Protonymph

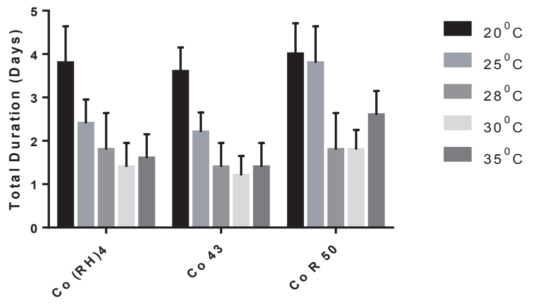
35 °C. It was variable with the temperatures (Table 1, 2 and 3).

The variety Co (RH) 4 influencing comparatively long days for the completion of total life cycle 17.4, 14.8, 9.6 and 9.6 days at 20, 25, 28, 30 and 35 °C respectively, whereas Co 43 recorded short period of 14.0, 9.0, 6.8, 6.6 and 5.7 days at 20, 25, 28, 30 and 35 °C Table 1 and 2 (Fig. a, b and c). The total development time of *O. oryzae* decreased over the temperature range of 20-35 °C. Similar results were reported on *Oligonychus coffeae* (Nietner) [8] and *T. truncates* [15]. The development time decreased for each developmental stage as temperature increased and was common for tetranychid mites while the most rapid development of many spider mite species occurred between 20 and 29 °C [3].

The adult females lived for minimum 6.6 to maximum 14.6 days. Co (R) 50 positively influencing the adult female longevity of 14.6, 13.2, 9.0, 9.0 and 6.6 days at 20, 25, 28, 30 and 35 °C (Table 3), whereas negatively influenced by Co 43 (Fig. f). The same trends were observed on adult male longevity (Fig.g). The quiescent stage after each moult was brief.

The total life cycle from egg to adult was short at 35°C on all the three varieties, whereas Co 43 recorded very short period compare to Co (RH) 4 and Co (R) 50. Development time for completion of the life cycle of *O. oryzae* decreased significantly with increasing temperature. A similar result was reported in *Tetranychus truncates* Ehara, where the longest life cycle of 16.1 days at 20 °C and the shortest life cycle of 8.33 days at 35 °C [15].

The rate of development increased rapidly between 25 and 28 °C, but slowly, between 20 and 25 °C. Moreover,



d. Deutonymph

approximately 35-40% of total life cycle was spent in the embryonic stage at 20 and 25 °C as compared to 30-31% at other temperatures. Those results were resemble with the findings of *Oligonychus perseae* Tuttle, (32-42%) at 25-30 °C [1], *Schizotetranychus celarius* (Banks) (44%) at 25 °C [14].

Increased temperature will positively influencing the *O.oryzae* multiplication, decreasing the life cycle period and increase total life cycle at particular period. temperatures are known to decrease the duration of the life cycle in several mite species [15 and 16].

Table 1. Developmental duration of *Oligonychus oryzae* on rice variety Co (RH)4 at different temperature

Stage/Instar	Duration of developmental stages (Days) (Mean* ± S.D.)					CD (0.05)
	20^{0}C	25^{0}C	28^{0}C	30^{0}C	35^{0}C	
Egg	5 +0.71^{a}	4.4 ± 0.55^{a}	2.4 ± 0.55^{b}	2.6±0.89^{b}	1.8±0.84^{b}	0.951
Larva	3.4 +0.55^{a}	2.6 ± 0.89^{abc}	3.2 ± 0.84^{ab}	2±0.71^{c}	2.4±0.55^{bc}	0.951
Protonymph	2.4 +0.55^{a}	1.4 ± 0.55^{b}	1.6 ± 0.55^{b}	1.4±0.55^{b}	1.2±0.45^{b}	0.698
Deutonymph	3.8 +0.84^{a}	2.4 ± 0.55^{b}	1.8 ± 0.84^{bc}	1.4±0.55^{c}	1.6±0.55^{bc}	0.894
Total duration	**14.6 +1.82^{a}**	**10.8 ± 1.30^{b}**	**9 ± 1.58^{c}**	**7.4±0.89^{cd}**	**7±0.71^{d}**	1.750
Adult female longevity	13.6 +0.89^{a}	11.2 ± 0.84^{b}	8.6 ± 0.89^{c}	7.8±0.84^{c}	6.4±0.55^{d}	1.071
Adult male longevity	8.4 +0.55^{a}	7.8 ± 0.84^{a}	5.6 ± 1.14^{b}	5.4±0.55^{b}	4.8±0.84^{b}	1.071

*Means followed by the same letter are not significantly different at 0.05 levels as determined by LSD

Table 2. Developmental duration of *Oligonychus oryzae* on rice variety Co 43 at different temperature

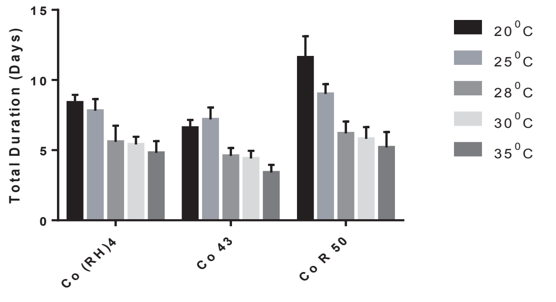
Stage/Instar	Duration of developmental stages (Days) (Mean* ± S.D.)					CD (0.05)
	20^{0}C	25^{0}C	28^{0}C	30^{0}C	35^{0}C	
Egg	4.8 +0.84^{a}	3.4 ± 0.55^{b}	2.2 ± 0.45^{c}	2.2±0.45^{c}	1.2±0.45^{d}	0.746
Larva	3.2 +0.45^{a}	2.2 ± 0.45^{b}	1.8 ± 0.45^{b}	2±1.00^{b}	1.6±0.55^{b}	0.813
Protonymph	2.4 +0.55^{a}	1.2 ± 0.45^{b}	1.4 ± 0.55^{b}	1.2±0.45^{b}	1.2±0.45^{b}	0.646
Deutonymph	3.6 +0.55^{a}	2.2 ± 0.45^{b}	1.4 ± 0.55^{c}	1.2±0.45^{c}	1.4±0.55^{c}	0.672
Total duration	**14 +0.71^{a}**	**9 ± 0.71^{b}**	**6.8 ± 1.10^{c}**	**6.6±2.07^{c}**	**5.7±1.52^{c}**	1.750
Adult female longevity	11.2 +0.84^{a}	10 ± 0.71^{b}	7.4 ± 0.55^{c}	6.4±0.55^{d}	4.4±0.55^{e}	0.855
Adult male longevity	6.6+0.55^{a}	7.2 ± 0.84^{a}	4.6 ± 0.55^{b}	4.4±0.55^{b}	3.4±0.55^{c}	0.813

*Means followed by the same letter are not significantly different at 0.05 levels as determined by LSD

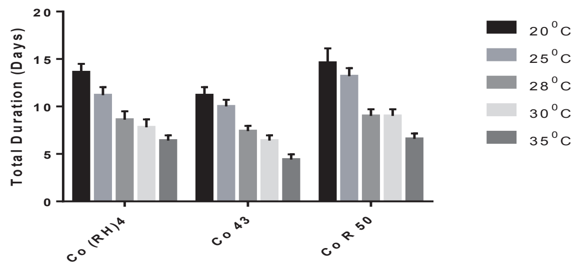
Table 3. Developmental duration of *Oligonychus oryzae* on rice variety Co (R) 50 at different temperature regimes

Stage/Instar	Duration of developmental stages (Days) (Mean* ± S.D.)					CD (0.05)
	20^{0}C	25^{0}C	28^{0}C	30^{0}C	35^{0}C	
Egg	5.8 ±0.84^{a}	5.6 ± 0.89^{a}	3 ± 0.71^{b}	2.8±0.45^{b}	2.2±0.45^{b}	0.914
Larva	4.6 ±0.55^{a}	3.2 ± 0.84^{b}	2.6 ± 0.55^{b}	3.2±0.84^{b}	2.6±0.55^{b}	0.894
Protonymph	3 ±0.71	2.2 ± 0.45	2.2 ± 0.84	1.8±0.45	2.2±0.45	NS
Deutonymph	4 ±0.71^{a}	3.8 ± 0.84^{a}	1.8 ± 0.84^{b}	1.8±0.45^{b}	2.6±0.55^{b}	0.914
Total duration	**17.4 ±1.34^{a}**	**14.8 ± 1.64^{b}**	**9.6 ± 1.52^{c}**	**9.6±1.34^{c}**	**9.6±0.55^{c}**	1.760
Adult female longevity	14.6 ±1.52^{a}	13.2 ± 0.84^{b}	9 ± 0.71^{c}	9±0.71^{c}	6.6±0.55^{d}	1.223
Adult male longevity	11.6 ±1.52^{a}	9 ± 0.71^{b}	6.2 ± 0.84^{c}	5.8±0.84^{c}	5.2±1.10^{c}	1.371

*Means followed by the same letter are not significantly different at 0.05 levels as determined by LSD



g. Adult Male Longivity



f. Adult Female Longivity

4. Conclusion: Rice mite, *O.oryzae* is an important species, which will increasing their ability to drive in paddy ecosystem as the favorable environment begins the way by global warming, seasonal failure, long drought and monsoon failure. The present studies confound that, the 28 – 35°C temperature positively influencing the developmental rate of rice mite. The varieties of Co RH 4, Co 43 and Co (R) 50 are popularly grown in Tamil Nadu, India, among these varieties Co 43 results highly susceptible at 30 – 35°C whereas Co (R) 50 shows moderately resistance. Hence, the studies on the biology and developmental duration at elevated temperature, future studies on antixenosis and antibiosis will help to the farmer's better management for controlling the rice leaf mite and to increase the production and productivity.

References:

1. *Dr. Archana Kushwaha,* Photo-Oxygenation of Ferrocene in Presence of Rose Bengal and Hexane As A Solvent; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Spl Issue (2015): Pg 77-79
2. O. Aponte, and J.A. McMurtry, Biology, life table and mating behavior of Oligonychus perseae (Acari: Tetranychidae). Int. J. Acarol. Vol.23, 1997,pp 199-207.
3. J.J. Beard, and G.H. Walter, Host plant specificity in several species of generalist mite predators. Ecol. Entomol. Vol.26, 2001,pp 562-570.
4. H.B. Boudreaux, Biological aspects of some phytophagous mites. Annu. Rev. Entomol. Vol.8, 1963,pp 137-154.
5. M.C. Cherian, South Indian Acarina. J. Asiat. Soc. Berg. Cal. Vol.27(1), 1931,pp11-147.
6. M.C. Cherian, Mites (Acarina) pests of crops in South India and methods of their control. Agric. Livestock India, Vol.8(5), 1938,pp 537-540.
7. J. Etienne, Current entomological problems of rice cultivation in Casamance (Senegal) area. Agron Trop. Ser. Riz Rizi. Cult. Vivrieres Trop, Vol.42,1987,pp 47-60.
8. *Weldegerima Kide, Balkrishna Desai, Shalu Kumar,* Nutritional Improvement and Economic Value of Hydroponically Sprouted Maize Fodder; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Issue 2 (2015): Pg 76-79
9. J. Gutierrez and J. Etienne, Quelques données sur les acariens Tetranychidae attaquant les plantes cultivees au Senegal. Agron. Trop, Vol.36, 1981, pp391-394.
10. M., Haque, A. Wahab, N. Naher and B. Afroza, (). Developmental stages of red spider mite, Oligonychus coffeae Neitner (Acari: Tetranychidae) infesting rose. Univ. J. Zool. Rajshahi. Univ, Vol. 26, 2007,pp71-72.
11. P. Karuppuchamy, R. Veluswamy, R. Rajendran and P.C. Sunderbabu, Rice mite, Oligonychus oryzae Hirst incidences on IR lines. Intern. Rice Res. Newsl, Vol.12(2), 1987, p 20.
12. B.C. Misra and P. Israel, Studies on the bionomics of the paddy mite, Oligonychus oryzae Hirst. (Acarina: Tetranychidae). Oryza, Vol.5, 1968, pp 32-37.
13. *P.B.Reddy, Jitendra Gupta, P.Sushma,* Recent Trends in Smart Drug Delivery; Life Sciences international Research Journal , ISSN 2347-8691, Volume 2 Issue 1 (2015), Pg 87-91
14. K.R. Nagarajan, A short note on Paratetranychus oryzae Hirst., the paddy mite. Madras Agric. J, Vol.44,1957, p 480.
15. P.S. Rai, G. P. Channa Basavanna, and B. K. Nageshchandra, Oligonychus oryzae Hirst (Acarina: Tetranychidae) as pest of rice in Karnataka and its control. Acar. Newsl, Vol.4, 1977, p 3.

16. V. Radhakrishnan and K. Ramaraju, Development Durations, Colonization and Insecticide Efficacy of Leaf Mite, Oligonychus oryzae Hirst on Rice. Tropical Agricultural Research. Vol.21 (1), 2009, pp30 – 38
17. Y. Saito, Comparative studies on life histories of three species of spider mites (Acarina: Tetranychidae). Appl. Entomol. Zool,Vol.14, 1979, pp 83-94.
18. S. Sakunwarin, A. Chandrapatya and G.T. Baker, Biology and life table of the cassava mite,Tetranychus truncatus Ehara (Acari:Tetranychidae). Syst. Appl. Acarol, Vol.8, 2003, pp 13- 24.
19. L.K. Tanigoshi, S.C. Hoyt, R.W. Browne and J.A. Logan, Influence of temperature on population increase of Tetranychus mcdanieli (Acarina: Tetranychidae). Ann. Entomol. Soc. Am. Vol.68, 1975, pp 972-978
20. *Shruti L. Samant, Amita M. Kocharekar,* Microfluidics System for The Entrapment and Detection of Oocysts of *Cryptosporidium*; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Spl Issue (2015): Pg 153-158

Vinoth Kumar,
Ph.D Scholar, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India
S, K. Ramaraju,
Director i/c, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.