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Biology and Seasonal Abundance of Rice Leaf Mite, *Oligonychus oryzae*

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An investigation on the biology and seasonal abundance of the rice leaf mite, *Oligonychus oryzae* Hirst was carried out by conducting lab and a field experiments. Egg, larval, protonymphal and duetronymphal periods lasted for 3-5 days, 1-2 days, 1-2 days and 1-2 days, respectively. Adult longevity of female and male varied from 7-8 days and 5-6 days, respectively. Unmated males lived for 9 days. Among the seven species of monocot weed plants, the highest population of mite was recorded in *Chloris barbata* (2.80/leaf) and *Saccharum* sp. (2.46/leaf). The lowest number of 0.43 eggs per leaf was recorded in February sowing and the high number of eggs was noticed in March, May and August sowings. Nymph and adult mite populations were high in April sowing. The lowest number of 0.12 nymph and 0.17 adult per leaf was observed in November and June sowing, respectively. Rice mite preferred 35 to 49 days old seedlings of rice. Very young stage and old stage plants did not support higher population of rice mite.

Keywords: leaf mite, rice, seasonal abundance, weed hosts, biology

Rice, *Oryza sativa* Linnaeus is an important cereal and staple food crop for more than 65 per cent of the world's population (Mathur *et al.,* 1999). Of the several limiting abiotic and biotic factors, the insect pests are the worst to hit rice production and productivity. Due to the changing climate and human interventions in rice cultivation, minor pests have become major concern. In the recent years the mites are more prevalent in many crops including rice. The rice leaf mite, *Oligonychus oryzae* Hirst (Acarina; Tetranychidae) infests rice leaves, leading to yellowing and drying. (Rao *et al*., 1993; Rao and Prakash, 1995). This mite has been reported to cause economic damage to the crop in Raichur district of Karnataka (Anon., 1998), Kanyakumari and Vellore districts of Tamil Nadu (Anon., 2000).

In Karaikal region of the Puducherry State, rice leaf mite occurs throughout the year and causes moderate to severe damage in different seasons in the recent years. But the seasonal abundance and biology of the mite were not studied in detail in this region. Hence, the present investigations were taken up 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.

Materials and Methods

Mass culturing

In order to get a healthy and homogenous culture, mites were collected initially from rice field and released on rice seedlings raised in plastic cups at second leaf stage and observations were made on life stages. Laboratory rearing was done at 25± 20ºC and 75± 5% RH.

Biology

Biology of *Oligonychus oryzae* was studied on rice leaf bits (4 cm long) placed with their under surface up on wet cotton in a Petri dish (10 cm dia.). Females of *O. oryzae* were released on the leaf bits and removed after eggs were laid. With the help of a fine camel hair brush an egg of *O. oryzae* was transferred to each leaf bit. Observations were taken once in 6 h till the mite metamorphoses to an adult. The mid point between of two observations was considered as the time of moulting, whenever a change to the next instar was observed. Based on this the duration of nymphal stage was determined. Adults emerged out were further confined for studying the longevity and fecundity.

Survey on population and seasonal abundance

Monocot, grassy weed plants around the rice fields were collected and observed under microscope to detect the mites. In each species of weed, five plants were collected and examined for leaf mites on three leaves at top, middle and bottom.

Seasonal abundance of rice mite was monitored in a field experiment by taking up monthly sowing of rice for one year using the rice variety ADT-36. The unit plot size was 5m x 4m. Sowing was done on the first day of every month from February 2006 to December 2006 with three replications in a

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Randomized Block Design. Seeds were sown at a spacing of 20 cm between two rows and 10 cm between plants. After sowing, periodical observations were made from the fifth week onwards up to tenth week by counting on ten plants randomly in each plot on the standing crop.

Table 1. Biology of rice mite, *Oligonychus oryzae* Hirst

Stages	Range	Mean ± SE
Egg period (Days)	3-5	4.57 ± 1.09
Larvae (Days)	1	1.27 ± 0.12
Protonymph (Days)	1-2	1.78 ± 0.37
Deutonymph (Days)	1-2	1.98 ± 0.51
Adult - Female (Days)	7-13	12.57 ± 0.24
Adult -Mated male (Days)	5-6	7.62±0.64
Adult - Unmated male (Days)	9	8.94±0.92
Total development period (Days)	12-13	11.57 ± 1.34
Fecundity (eggs/ female)	12-13	12.78 ± 0.25

Results and Discussion

The data on the biology of rice mite are given in Table 1. The egg period lasted for 3-5 days. Periods of larva, protonymph and deutronymph lasted for 1, 1-2 and 1-2 days, respectively. Female lived for 7-13 days, whereas males lived for 5-6 days. An adult female laid about 12-13 eggs. The developmental periods of various stages are in consonance with the report of Misra and Israel (1968). Cherian (1933) also reported that the egg stage of cholam mite lasted for 3-4 days.

Population of mites were also recorded on monocot weed plants viz., *Panicum repens* L., *Echinocloa* sp. L. *Chloris barbata* (L.). S.W., *Dactylactenium aegyptium* (L.) Wild., *Cyanodan dactylon* (L) Pres. *Dinebra retroflexa* (Vahl) Panzer (Table 2). The highest population of mite was observed in *C. barbata* (2.80/leaf) and *Saccharum sp* (2.46/leaf). The lowest number of mite was observed on C. *dactylon* (0.63/leaf), D. *retroflexa* and *P*. *repens* (0.13/leaf). The field survey elucidated that among the seven weed plants, *Chloris barbata* (L).SW. and *Saccharam* sp. were the most preferred weed plants. It was also reported by Misra and Israel (1968) that the population of mite was recorded on the grasses viz., *Panicum coloratum*, *Panicum crusgalli* and *Cyanodon dactylon*.

Table 2. Life stages of mites in monocot weeds

Weed	Life stages/leaf			
	Eggs	Nymphs	Adults	Mean
Panic grass, *Panicum repens*	0.0	0.3	0.1	0.13
	(0.71) c	(0.89)c	(0.75)b	(0.79)c
Banyard grass, *Echinochloa* sp.	2.2	0.6	0.1	0.97
	(1.02)b	(1.02)b	(0.76)b	(1.21)b
Finger grass, *Chloris barbata*	5.6	2.2	0.6	2.80
	(2.21)a	(1.49)ab	(1.01)a	(1.82)a
Crowfoot grass, *Dactylactenium aegypticum*	0.6	0.1	0.0	0.26
	(0.7)b	(0.79)c	(0.71)b	(0.85)bc
Hariyali, *Cyanodan dactylon*	0.7	0.6	0.6	0.63
	(1.06)b	(1.05)c	(1.06)b	(1.06)bc
Vanear grass, *Dinebra retroflexa*	0.0	0.6	0.0	0.20
	(0.71)c	(1.05)c	(0.71)b	(0.84)bc
Kans, *Saccharam* sp.	3.00	2.5	1.87	2.46
	(1.82)ab	(1.71)ab	(1.35)a	(1.72)a
CD (0.05%)	0.80*	0.55*	0.19*	0.35**

Figures in the parentheses are “(X+0.5) transformed values, Mean values followed by same letter in a column are not significantly different
*Significant at 5 % level and **Significant at 1 % level

Population fluctuation showed that April month sown crop recorded the highest number of eggs of 1.37 per leaf (Table 3). The lowest number of 0.43 eggs per leaf was noticed in February sowing. The suitable stage of the crop elucidated that mean values did not show much differences. However, the high mean value of 0.50 eggs per leaf was recorded between 53 and 84 DAS that was the vulnerable stage of the crop. Rice crop sown in April and March recorded the highest number of nymphs of 2.08 and 2.04 per leaf respectively (Table 4). The lowest number of 0.12 nymph per leaf was seen in November sowing. Nymphs attacked all stages of the crop, because all stages of the crop had variation among the mite populations in all the months except December.

The population of adult mite showed that the April month sowing recorded the highest number of adults with a mean value of 2.30 per leaf (Table 5). The lowest number of adult mite was observed in June sowing (0.17/leaf). Higher overall mean values of 1.13, 1.33, 1.11 and 1.03 adult mites per leaf were recorded at 56 DAS, 77 DAS, 84 DAS and 91 DAS, respectively. Overall mean values indicated that all stages of rice crop were preferred by the adult mite. However, there was no mite population at 63 DAS in February sowing. Considering the stage of the crop, it was also evident from the data that the rice mite preferred 35 to 49 days old seedlings of rice. The overall mean indicated that very young stage and old stage plants did not support higher population

Table 3. Population of rice mites (Eggs) in different months of sowing during 2007

Month/ stages of crop	Eggs per leaf											
	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Mean
35DAS	0.03	0.00	1.07	0.77	0.63	0.13	0.80	0.00	0.00	0.00	0.00	0.31
	(0.89)^{cd}	(0.71)^{e}	(1.03)^{de}	(0.84)^{NS}	(1.06)^{NS}	(0.8)^{de}	(1.13)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
42 DAS	0.13	0.17	2.47	0.67	0.63	0.07	0.43	0.00	0.00	0.00	0.00	0.41
	(0.80)^{d}	(0.80)^{e}	(1.56)^{a}	(0.79)^{NS}	(1.06)^{NS}	(0.75)^{e}	(0.95)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
49 DAS	0.07	0.67	2.13	0.70	0.83	0.27	1.13	0.00	0.00	0.00	0.00	0.52
	(0.75)^{d}	(1.08)^{c}	(1.46)^{ab}	(0.84)^{NS}	(1.15)^{NS}	(0.87)^{cde}	(1.27)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
56 DAS	0.03	0.23	2.07	0.67	0.53	0.10	0.97	0.00	0.00	0.00	0.00	0.41
	(0.73)^{d}	(0.85)^{dc}	(1.44)^{ab}	(0.81)^{NS}	(1.01)^{NS}	(1.26)^{a}	(1.21)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
63 DAS	0.00	0.77	1.60	0.70	0.60	1.10	0.80	0.00	0.00	0.00	0.00	0.50
	(0.71)^{d}	(1.12)^{bc}	(1.25)^{bc}	(0.82)^{NS}	(1.03)^{NS}	(1.26)^{a}	(1.13)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
70 DAS	0.07	2.33	0.87	0.90	0.30	0.47	0.77	0.00	0.00	0.00	0.00	0.51
	(0.75)^{d}	(1.67)^{a}	(0.92)^{e}	(0.86)^{NS}	(0.89)^{NS}	(0.97)^{bcde}	(1.12) ^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
77 DAS	0.63	2.17	1.40	0.90	0.43	0.90	0.80	0.00	0.00	0.00	0.00	0.65
	(1.03)^{bc}	(1.63)^{a}	(1.16)^{cd}	(0.94)^{NS}	(0.96)^{NS}	(1.17)^{ab}	(1.14)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
84 DAS	1.30	1.93	0.67	0.93	0.23	0.80	0.30	0.00	0.00	0.00	0.00	0.56
	(1.34)^{a}	(1.56)^{a}	(0.81)^{e}	(0.96)^{NS}	(0.85)^{NS}	(1.12)^{ab}	(0.89)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
91 DAS	0.97	1.20	0.73	0.67	0.23	0.57	0.50	0.00	0.00	0.00	0.00	0.44
	(1.20)^{ab}	(1.30)^{b}	(0.86)^{e}	(0.79)^{NS}	(0.84)^{NS}	(1.03)^{abcd}	(0.99)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
98 DAS	1.07	0.53	0.70	0.67	0.27(0.8)	0.70	0.67	0.00	0.00	0.00	0.00	0.41
	(1.25)^{ab}	(1.02)^{cd}	(0.83)^{e}	(0.71)^{NS}	7^{NS}	(1.09)^{abc}	(1.07)^{NS}	(0.71)	(0.71)	(0.71)	(0.71)	
Mean	0.43	1.00	1.37	0.75	0.46	0.51	0.71	0	0	0	0	-
CD (0.05%)	0.23*	0.19*	0.22*	NS	NS	0.24*	NS	NS	NS	NS	NS	0.57*

Figures in the parentheses are (X+0.5) transformed values, Mean values followed by same letter in a column are not significantly different *Significant at 5 % level; NS - Non Significant, DAS - Days after spraying

of rice mite. Similar results were reported by Menon *et al.* (2007).

O. oryzae incidence occurred throughout the year, but it started building up in the later part of December and gradually increased. Mites attained peak activity during April - May (Summer) and August-September (Pre North East monsoon) in Karaikal region. Low activity was observed during June, November, December and January. The fluctuation in mite population was found to be closely associated with the weather factors. Rahaman and Sapra (1940) and Maragal (1977) observed that increase in temperature along with fairly low relative humidity enhanced mite population. On the other hand low

Table 4. Population of rice mites (Nymphs) in different months of sowing during 2007

Month/ stages of crop	Nymphs per leaf											
	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Mean
35DAS	0.83	1.03	1.97	1.77	1.50	0.90	1.90	1.67	0.80	0.47	0.37	1.20
	(0.91)^{cd}	(0.96)^{e}	(1.40)^{cde}	(1.33)^{bcd}	(1.22)^{bc}	(0.94)^{e}	(1.37)^{ab}	(1.29)^{a}	(0.89)^{a}	(0.68)^{ab}	(0.60)^{NS}	
42 DAS	1.20	1.27	3.27	1.00	1.10	1.20	1.40	1.57	0.67	0.50	0.53	1.24
	(1.09)^{bcd}	(1.06)^{de}	(1.80)^{a}	(0.99)^{e}	(1.05)^{cd}	(1.08)^{cde}	(1.18)^{bc}	(1.25)^{a}	(0.81)^{abcd}	(0.70)^{ab}	(0.73) ^{NS}	
49 DAS	0.50	2.07	2.63	1.50	1.43	1.33	1.67	1.47	0.60	0.30	0.60	1.28
	(0.70)^{d}	(1.44)^{bc}	(1.62)^{b}	(1.22)^{d}	(1.20)^{bc}	(1.15)^{bcde}	(1.29)^{ab}	(1.21)^{a}	(0.77)^{abcd}	(0.35)^{cde}	(0.74)^{NS}	
56 DAS	1.00	2.00	2.43	1.43	1.43	1.80	1.87	1.03	0.77	0.40	0.50	1.32
	(1.00)^{bcd}	(1.41)^{bcd}	(1.56)^{bc}	(1.20)^{d}	(1.20)^{bc}	(1.34)^{ab}	(1.35)^{ab}	(1.01)^{b}	(0.87)^{ab}	(0.63)^{abc}	(0.70)^{NS}	
63 DAS	0.60	1.97	2.83	1.63	2.13	2.13	1.60	0.03	0.70	0.53	0.80	1.35
	(0.77)^{cd}	(1.39)^{bcd}	(1.68)^{cd}	(1.28)^{bcd}	(1.46)^{a}	(1.44)^{a}	(1.26)^{ab}	(0.02)^{b}	(0.84)^{abc}	(0.73)^{a}	(0.89)^{NS}	
70 DAS	1.23	3.43	2.03	2.37	1.40	1.40	1.43	0.53	0.4	0.30	0.80	1.39
	(1.10)^{bc}	(1.85)^{a}	(1.42)^{def}	(1.54)^{a}	(1.17)^{bc}	(1.18)^{bcd}	(1.20)^{bc}	(0.71)^{c}	(0.68)^{bcde}	(0.55)^{cde}	(0.88)^{NS}	
77 DAS	2.00	2.20	1.60	1.43	1.73	1.73	1.00	0.90	0.30	0.27	0.80	1.26
	(1.36)^{ab}	(1.48)^{bc}	(1.26)^{f}	(1.20)^{d}	(1.31)^{ab}	(1.32)^{abc}	(1.00)^{c}	(0.95)^{b}	(0.53)^{e}	(0.50)^{de}	(0.88)^{NS}	
84 DAS	2.97	2.37	1.40	1.60	0.83	1.13	1.87	0.73	0.43	0.20	0.83	1.30
	(1.70)^{a}	(1.54)^{abc}	(1.17)^{f}	(1.25)^{cd}	(0.91)^{d}	(1.06)^{de}	(1.36)^{ab}	(0.85)^{bc}	(0.64)^{cde}	(0.44)^{e}	(0.90)^{NS}	
91 DAS	2.93	2.57	1.53	2.03	2.03	1.23	2.10	0.73	0.50	0.33	0.90	1.55
	(1.69)^{a}	(1.60)^{ab}	(1.24)^{ef}	(1.42)^{abc}	(1.42)^{abc}	(1.11)^{bcde}	(1.45)^{a}	(0.85)^{bc}	(0.70)^{abcde}	(0.58)^{bcd}	(0.93) ^{NS}	
98 DAS	3.00	1.50	1.20	2.13	1.63	1.47	2.10	0.57	0.40	0.40	0.53	1.35
	(1.73)^{a}	(1.22)^{cde}	(1.10)^{f}	(1.46)^{ab}	(1.27)^{abc}	(1.21)^{abcd}	(1.45)^{a}	(0.74)^{c}	(0.63)^{de}	(0.63)^{abc}	(0.67) ^{NS}	
Mean	1.62	2.04	2.08	1.68	0.29	1.43	1.69	0.92	0.57	0.37	0.66	-
CD (0.05%)	0.39*	0.33*	0.17*	0.19*	0.22*	0.23*	0.23*	0.18*	0.20*	0.12*	NS	0.43*

Figures in the parentheses are v(X+0.5) transformed values, Mean values followed by same letter in a column are not significantly different, *Significant at 5 % level; NS-Non Significant, DAS - Days after spraying

Table 5. Population of rice mite (Adults) in different months of sowing during 2007

Month/ stages of crop	Adults per leaf											
	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Mean
35DAS	0.63 (1.06)^{def}	0.23 (0.84)^{f}	2.57 (1.60)^{bc}	1.57 (1.43)^{a}	1.23 (1.32)^{a}	0.50 (0.80)^{e}	0.90 (1.16)^{abcd}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.69
42 DAS	0.93 (1.20)^{bcde}	0.43 (0.92)^{f}	3.90 (1.97)^{a}	1.57 (1.43)^{ab}	1.23 (1.31)^{a}	1.20 (0.94)^{de}	0.67 (1.08)^{bcde}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.90
49 DAS	0.50 (1.00)^{efg}	1.60 (1.44)^{de}	3.43 (1.85)^{ab}	1.57 (1.43)^{a}	1.47 (1.40)^{a}	1.10 (0.92)^{de}	0.43 (0.96)^{de}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.91
56 DAS	0.20 (0.84)^{fg}	1.40 (1.36)^{e}	3.87 (1.97)^{a}	1.20 (1.30)^{abc}	1.43 (1.39)^{a}	3.40 (1.28)^{abc}	0.93 (1.19)^{abcd}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.13
63 DAS	0.00 (0.71)^{g}	2.60 (1.76)^{abc}	2.10 (1.45)^{c}	1.10 (1.26)^{abc}	0.37 (0.90)^{b}	2.10 (1.09)^{cd}	1.57 (1.42)^{a}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.89
70 DAS	0.83 (1.15)^{cdef}	3.63 (2.03)^{ab}	1.83 (1.35)^{cd}	0.43 (0.94)^{d}	0.13 (0.80)^{b}	1.40 (0.97)^{de}	1.10 (1.26)^{abc}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.85
77 DAS	1.37 (1.34)^{bcd}	3.23 (1.93)^{ab}	1.90 (1.35)^{cd}	0.83 (1.15)^{bcd}	0.50 (1.00)^{b}	5.70 (1.54)^{a}	1.20 (1.30)^{ab}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.33
84 DAS	1.63 (1.43)^{abc}	3.73 (2.06)^{a}	1.37 (1.17)^{de}	0.87 (1.16)^{abcd}	0.27 (0.87)^{b}	4.20 (1.36)^{ab}	0.23 (0.85)^{e}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.11
91 DAS	1.77 (1.49)^{ab}	2.53 (1.74)^{bcd}	1.10 (1.04)^{e}	1.30 (1.34)^{abc}	0.30 (0.88)^{b}	3.80 (1.33)^{abc}	0.53 (1.00)^{cd}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.03
98 DAS	2.43 (1.70)^{a}	2.47 (1.56)^{cde}	1.00 (0.99)^{e}	0.77 (1.12)^{cd}	0.23 (0.85)^{b}	3.30 (1.26)^{bc}	0.70 (1.09)^{bcde}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.99
Mean	1.02	2.18	2.30	1.12	0.71	2.16	0.82	0	0	0	0	-
CD (0.05%)	0.32*	0.31*	0.26*	0.28*	0.22*	0.26*	0.28*	NS	NS	NS	NS	0.36*

Figures in the parentheses are v(X+0.5) transformed values, Mean values followed by same letter in a column are not significantly different *Significant at 5 % level; NS - Non Significant, DAS - Days after spraying

temperature combined with fairly high relative humidity was found to be unfavorable and there was decline in population. Gupta *et al.* (1974) also reported the occurrence of less mite populations at low temperature and high humidity.

The present studies suggest that the immature stages lasted for 3-5 days with a life span of 12 and 14 days, respectively, in adult male and female mites. Among monocot weed plants studied, *Chloris barbata* and *Saccharum* sp. had higher population of mites as preferred alternate hosts in the Karaikal region of Puducherry State. Rice mites preferred 35 to 49 days old seedlings of rice. April-May and August-September are the most preferred months of occurrence for this rice mite.

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