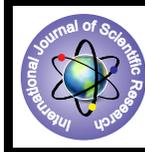


Influence of Temperature and Relative Humidity on Oviposition and Fecundity of *Oligonychus Biharensis* (Hirst) (Acari: Tetranychidae)– A Pest on Cassava



Zoology

KEYWORDS : *Oligonychusbiharensis*, *Manihot esculenta*, Oviposition, Relative humidity, Fecundity.

* Sangeetha G. Kaimal

Department of Zoology, Providence Women's College, Calicut, Kerala-673 009, India.
* Corresponding Author

N. Ramani

Department of Zoology, University of Calicut, Malappuram, Kerala-673 635, India.

ABSTRACT

The impact of temperature and relative humidity on the oviposition and fecundity of the spider mite, Oligonychus biharensis (Hirst) infesting Manihot esculenta, was studied under 3 constant temperature-humidities combination of 35+20C & 60+5%RH, 30+20C & 70+5%RH and 25+20C & 80+5%RH. Shortest pre-oviposition period (0.5+0.12 days) was noted at 35 + 20C & 60 + 5% RH followed by 30 + 20C & 70 + 5% RH (1.6+0.1 days) and highest at 25 + 20C & 80 + 5% RH (1.9+0.07 days). Humidity had little influence on the pre-oviposition and post-oviposition periods when compared to temperature. Fecundity was recorded highest at 35 + 20C & 60 + 5% RH (75.6+0.9 eggs per female) followed by 30+20C & 70+5%RH (58.7+0.9 eggs per female). Lowest number of eggs was laid at 25+20C & 80+5%RH (26.7+0.6 eggs per female). Higher humidity had negative impact on the egg laying capacity as shown by adult females. A decrease in the duration of oviposition period was recorded at low temperatures and higher humidities. Of all the different temperature-humidity conditions provided, the combination of 35+20C & 60+5%RH was found to be best suited for the successful survival and development of the mite O. biharensis on M. esculenta in alarming rates so as to acquire the status of a major pest This is almost in agreement with the temperature and humidity conditions prevalent during summer months when the population density of O. biharensis has attained the peak level in the field. The study elucidates that higher temperature and low relative humidity prevailing in the state of Kerala owing to global warming has beyond doubt elevated the status of these mites as dreadful pests well beyond threshold level.

INTRODUCTION

Oligonychus biharensis is a sporadic pest of vegetables, rose, camphor, litchi and many other plants of high importance. (Jeppson et al., 1975; Bonato et al., 1995). Feeding by this mite causes characteristic bronzing on leaves and severe damage to the host plant. Severe infestation and prolonged feeding results in crinkling, subsequent drying and defoliation of affected leaves. Attack by these mites normally affects the growth and vigour of host plants. In the present study, *Manihot esculenta* L. (cassava) proved to be a potential host for the successful establishment of *O. biharensis* throughout the year. Cassava is a robust productive starchy root crop that is grown chiefly as a food. The edible green leaves of cassava are a good source of protein, vitamins and minerals and are often used to augment the rural diet. Cassava roots combine high energy and high levels of some vitamins, minerals and dietary fibre. Cassava is also an important animal feed, and it has several significant industrial uses. But from the recent past it has also become a major horticultural export commodity, earning foreign exchange. Considering the nutritive value of the plant, ease of establishment and the infestation by dense populations of *O. biharensis* on it throughout the year, studies on the oviposition and fecundity of the mite were initiated.

MATERIALS AND METHODS

Studies on the development of *O. biharensis* were initiated on fresh leaves of cassava with petioles removed, excised from plants 3 -5 days after expansion and kept in 120mm petridishes lined with 110x110x5mm cotton pads. Live cultures of the mite were maintained in the labby leaf flotation technique (Sangeetha and Ramani, 2007). The effects of constant temperatures and RH were studied in an environmental growth chamber at temperature-humidity combinations of 35 +20C & 60 + 5% RH, 30 + 20C & 70 + 5% RH and 25 + 20C & 80 + 5% RH. Regular observations were made under 32x magnifications at ½ h interval, in order to gather information on oviposition and fecundity of *O. biharensis*. One way analysis of variance followed by paired T-test was carried out to compare the overall effect of temperature and RH on oviposition and egg laying of *O. biharensis*. The objective of this investigation was, therefore, to account on the influence of temperature and RH on the oviposition and fecundity of *O. biharensis* infesting cassava.

RESULTS AND DISCUSSION

Temperatures as well as relative humidity (RH) are known to influence the development and reproduction of several species of tetranychid mites (Bonato et al., 1990, 1995; Childers et al., 1991; Hong and Tsai, 1998; Bonato, 1999; Yueguan, et al. 2002; Badii et al., 2003; Kasap, 2003, 2004; Gotoh et al., 2004; Geralado, et al., 2004).

Pre-oviposition Period

RH was found to exert minimum effect on the pre-oviposition period of *O. biharensis*. Irrespective of the humidity ranges, the pre-oviposition period was shortest at 35+20C & 60+5%RH (0.5+0.12 days) followed by 1.6+0.1 days at 30+20C & 70+5%RH. Highest value of 1.9+0.07 days was recorded at 25+20C & 80+5%RH (Table I). However, temperature had significant influence on the duration of pre-oviposition period (p-value<0.01). The pre-oviposition period was found to decrease with increasing temperature (Bonato, 1999).

Oviposition Period

Temperature and RH had significant influence on the period of oviposition and the number of eggs laid by *O. biharensis*. With increase in temperature, rise in the duration of oviposition period was noted. Irrespective of the humidity ranges, the duration of oviposition period was reduced to 5.8+0.13 days at 25+10C & 80+5%RH and 6.75+0.28 days at 30+10C & 40+5%RH. Longest period of oviposition was recorded to be 8.4+0.5089 days at 34+10C & 50+5%RH (Table I). Data recorded were found to be statistically significant at 1% level (p-value<0.01). However, RH had little influence on the length of oviposition period except that it decreased this period at higher humidity level (80% RH). The oviposition period of *T. neocaledonicus* on lady's finger was reported to be 8-10 days and that on French bean was 13-19 days (Ray and Rai, 1981; Manjunatha and Puttaswamy, 1989) whereas on *M. oleifera* it was found to range from 5-9 days depending on the temperature and RH.

Fecundity

Fecundity was affected both by temperature and RH levels. As the temperature rose from 25°C to 34°C, the total fecundity and mean number of eggs laid per day increased (Bonato et al., 1990). The highest number of eggs (75.6 + 0.9 eggs per female) was laid at 35 + 2°C & 60 + 5% RH and lowest (26.7+0.63 eggs per female) at 25 + 2°C & 80 + 5% RH (Table II). The number of eggs

laid by a gravid female in her life time reduced significantly (p -value<0.01) at higher humidity levels. These observations are in support of earlier reports of Bonato et. al. (1995) in *Mononychellus progresivus* and *O. gossypii*, Puttaswamy and ChannaBasavanna (1980) in *T. ludeni* and Boudreaux (1958) in various spider mites. The number of eggs laid by individual female mite on *M. oleifera* was found to be much lower than that of earlier reports on other host plants (Gupta et al., 1974; Ray and Rai, 1981; Manjunatha and Puttaswamy, 1989; Kasap, 2004). Hence, temperature and RH act as decisive factors influencing egg production in the spider mite, *O. biharensis*.

Post-oviposition Period

The post-oviposition period was recorded to be 0.45 ± 0.032 days at $34 \pm 1^\circ\text{C}$ & $50 \pm 5\% \text{RH}$, 0.5 ± 0.03 days at $30 \pm 1^\circ\text{C}$ & $40 \pm 5\% \text{RH}$ and 0.51 ± 0.01 days at $25 \pm 1^\circ\text{C}$ & $80 \pm 5\% \text{RH}$ (Table I). Thus the post-oviposition period showed less significant difference (p -value=0.05) in duration for the above 3 temperature-humidity conditions. Similar observations on the effect of temperature were recorded by Bonato (1999) on *T. evansi* and Bonato et. al. (1990) on *Eotetranychus carpini*.

CONCLUSION

Of all the different temperature-humidity conditions provided, the combination of $35 \pm 2^\circ\text{C}$ & $60 \pm 5\% \text{RH}$ was found to be best suited for the successful survival and development of the mite *O. biharensis* on *M. esculenta* in alarming rates so as to acquire the

status of a major pest. Thus, the study elucidates that warmer temperature and low relative humidity exerts a direct influence on the developmental process of the mite. Further investigations concerning the influence of other biotic and abiotic factors on the life tables of *O. biharensis* should be conducted to obtain basic tools necessary to develop an adequate pest management programme.

ACKNOWLEDGEMENT

The authors are grateful to Dr. T.C. Narendran (Late), Emeritus Professor and Former Head, Department of Zoology, University of Calicut for his valuable suggestions during the tenure of research and the University of Calicut for financial support and facilities.

TABLE I - Impact of varying temperature-humidity conditions on Pre-oviposition, Oviposition and Post-oviposition periods of *O. biharensis*

Temperature (°C)	RH (%)	Pre-oviposition (days)	Ovi-position (days)	Post-oviposition (days)
$35 \pm 2^\circ\text{C}$	$60 \pm 5\%$	0.5 ± 0.12	8.4 ± 0.50	0.45 ± 0.03
$30 \pm 2^\circ\text{C}$	$70 \pm 5\%$	1.6 ± 0.1	6.75 ± 0.28	0.5 ± 0.03
$25 \pm 2^\circ\text{C}$	$80 \pm 5\%$	1.9 ± 0.07	5.8 ± 0.13	0.51 ± 0.01

n = 35

TABLE II - Influence of varying temperature-humidity conditions on fecundity of *O. biharensis*

Temp (°C)	RH (%)	Number of eggs laid on different days of oviposition								Total no. of eggs laid per female
		1	2	3	4	5	6	7	8	
35 ± 2	60 ± 5	3.9 ± 0.23	9.3 ± 0.3	14.2 ± 0.3	20.7 ± 0.6	17.3 ± 0.3	7.3 ± 0.34	3.9 ± 0.3	1.38 ± 0.2	75.6 ± 0.9
30 ± 2	70 ± 5	2.9 ± 0.16	7.0 ± 0.3	10.1 ± 0.3	16.8 ± 0.2	13.6 ± 0.7	6.5 ± 0.17	3.4 ± 0.2	-	58.7 ± 0.9
25 ± 2	80 ± 5	2.5 ± 0.16	4.4 ± 0.1	9.3 ± 0.3	6.4 ± 0.15	2.7 ± 0.14	1.4 ± 0.15	-	-	26.7 ± 0.6

n = 35

REFERENCE

- Badii, M.H., Varela, S., Flores, A.E. & Landeros, J. (2003). Temperature - based life history and life table parameters of Texas citrus mite on orange (Acari: Tetranychidae). *Sys. Appl. Acarol.* 8, 25-38. | Bonato, O. (1999). The effect of temperature on life history parameters of *Tetranychus evansi* (Acari: Tetranychidae). *Expt. Appl. Acarol.* 23(1), 11-19. | Bonato, O., Cotton, S.K. & Gutierrez, J. (1990). Influence of temperature on the life history parameters of the yellow grape vine mite *Eotetranychus carpini* (Oudemans) (Acari: Tetranychidae). *Int. J. Acarol.* 16(4), 241-246. | Bonato, O., Divassa, M.S. & Gutierrez, J. (1995). Influence of relative humidity on life-history parameters of *Mononychellus progresivus* and *Oligonychus gossypii* (Acari: Tetranychidae). *Environ. Entomol.* 24(4), 841-845. | Boudreaux, H.B. (1958). The effect of relative humidity on egg-laying, hatching and survival in various spider mites. *J. Ins. Physiol.* 2, 65-72. | Childers, C.C., Abou - Setta, M.M. & Nawar, M.S. (1991). Biology of *Eotetranychus banksi*: Life tables on 'marsh' grapefruit leaves at different temperatures (Acari: Tetranychidae). *Int. J. Acarol.* 17(1), 29-35. | Geraldo, V.J.N., Fernando, S.R. & Manoel, G.G.C. Jr. (2004). Effect of different temperatures on the development and reproduction of *Tetranychus abaceae* Baker & Pritchard (Acari: Tetranychidae) on *Musasp. cv. Prata*. *Neotrop. Entomol.* 33(2), 149-154. | Gotoh, T., Akiyuki, S., Shima, K.V., Yasuki & Hussien, R.A. (2004). Developmental and reproductive performance of *Tetranychus puercicola* Ehara and Gotoh (Acari: Tetranychidae) at four constant temperatures. *Appl. Entomol. Zool.* 39(4), 675-682. | Gupta, S.K., Dhooria, M.S. & Sidhu, A.S. (1974). Effect of food and temperature on the development, longevity and fecundity of sugarcane red spider mite *Oligonychus indicus*. *Acarol.* 16, 436-440. | Hong, L.Y. & Tsai, J.H. (1998). Development, survivorship and reproduction of *Tetranychus bimaculatus* Banks (Acari: Tetranychidae) in relation to temperature. *Int. J. Acarol.* 24(3), 245-252. | Jeppson, L.R., Keifer, H.H. & Baker, E.W. (1975). *Mites injurious to economic plants*, University of California Press, Berkeley, Los Angeles, London, 614 pp. | Kasap, I. (2003). Life history of hawthorn spider mite *Amphitetranychus viennensis* (Acari: Tetranychidae) on various apple cultivars and at different temperatures. *Expt. Appl. Acarol.* 31(1 & 2), 79-91. | Kasap, I. (2004). Effect of apple cultivar and of temperature on the biology and life table parameters of two spotted spider mite *Tetranychus urticae*. *Phytoparasitica*, 32(1), 73-82. | Manjunatha, M. & Puttaswamy, (1989). Life history of *Tetranychus neocaledonicus* under greenhouse conditions. *J. Acarol.* 11(1 & 2), 35-40. | Puttaswamy & ChannaBasavanna, G.P. (1980). Competition between *Tetranychus neocaledonicus* and *T. ludeni* (Acari: Tetranychidae). *Ind. J. Acarol.* 4(2), 49-54. | Ray & Rai (1981). Biology and Control of *Tetranychus neocaledonicus* (Acari: Tetranychidae) on lady's finger at Varanasi. In: ChannaBasavanna (G.P.) (Ed.). *Proceedings of All India Symposium in Acarology*, Acarological Society of India, University of Agricultural Sciences, India, 41-46. | Sangeetha, G.K. & Ramani, N. (2007). Chlorophyll loss due to infestation by *Tetranychus husneocaledonicus* (Andre) (Acari: Tetranychidae) on *Moringa oleifera* Lam. *J. Acarol.* 17 (1&2), 12-14. | Sharma, A. & Kushwaha, K.S. (1984). Susceptibility of different varieties of brinjal to *Tetranychus neocaledonicus* (Acari: Tetranychidae). *Ind. J. Acarol.* 6(2), 100-103. | Yueguan, F.U., Zhang, F., Penk, Z., Liu, K. & Jin, Q. (2002). The effect of temperature on the development and reproduction of *Tetranychus pierci* Mc. Gregor (Acari: Tetranychidae) in banana. *Sys. Appl. Acarol.* 7, 69-76. |