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RESEARCH ARTICLE

SEASONAL INCIDENCE AND BIOLOGY OF TETRANYCHUS CINNABARINUS ON PAPAYA IN WEST TRIPURA, NE INDIA

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ABSTRACT

Background: Mites of the family Tetranychidae are undoubtedly among the many destructive pests of different vegetables in many parts of the world. Since the degree of incidence of red spider mite changes with season, it is desirable to have a thorough understanding of the seasonal incidence of the mite. **Methods:** Seasonal incidence of Tetranychus cinnabarinus (Boisd.) on the local variety of Papaya (Carica papaya) was studied in 4 different localities of Agartala, Tripura(west) during February,2019-January2020. **Result:** The population was recorded on both sides of the leaf which was always more on the dorsal surface. The population density was highest during January, 2020 (1485.0/ 2X75cm.^{2} leaf surface area) and lowest (1.5/ 2X75cm.^{2} leaf surface area) during June, 2019 in all localities. During April-July number of egg, total immature and adult was very small in number. The biology of T.cinnabarinus was conducted under laboratory condition at room temperature and total time required for development from egg to adult emergence was 4.1-8.1 days. **Conclusion:** Study of the seasonal incidence of the phytophagus mite will be he helpful to the farmers of Tripura for successful management and growth of papaya.

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INTRODUCTION

The carmine spider mite, *Tetranychus cinnabarinus* is an extremely polyphagous plant mite and is described as a serious pest attacking vegetables, fruits, pulse crops, cotton and so on(Gupta 1985, Wang et al.,2004, Cakmak et al.,2005. They insert their stylets into their host leaves and suck the cell contents and damage protective leave surface, palisade layers, cause yellowing, crinkling, crumpling, curling and twisting of leaves (Jepson et al.,1975).In addition, they spin heavy webs on leaves which reduce photosynthesis and transpiration rate of plants(Hazen et al.,1974,1975),eventually the leaves dry up and fall off. Further, feeding by this mite severely affects the growth, flowering and fruit formation in crops(Kazak and Kibritci,2008). Therefore this mite has drawn the attention to the Acarologists from all over the world and considerable work has been done on its ecology, biology and control. In Tripura, Papaya is commonly cultivated. An ecological survey was conducted during February 2018 to January 2019 revealed that this plant received infestation of *T. cinnabarinus.* Considering the economic importance of the papaya and lack of information about attack of *T. cinnabarinus* on papaya in Tripura, the present study was undertaken on seasonal incidence and biology of *T. cinnabarinus.*

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MATERIALS AND METHOD

Site description: Tripura is situated in the North Eastern Region of India, surrounded by Bangladesh on the West, South and North. Its north eastern and eastern boundary is demarcated by the states of Assam and Mizoram respectively. The state lies between 22^0 56′ and 24^0 32′ N and 90^0 10′and $92^0$21′E with an average altitude of 12.8 Mt. The area experiences a temperature which ranges between 10^OC - 35^OC from winter to summer respectively, and an average annual rain fall of2100 mm.

Sampling: For studying the seasonal incidence of *T. cinnabarinus,* 4 different localities of west district of Tripura

namely Jogendranagar, Collegetilla, Anadanagar and Pratapgar were selected. Data was collected fortnightly during Feb.2019 to January 2020. For determining mite population each observation consisted of 5 leaves and from each leaf 5 spots of 2sq. cm. were randomly selected i.e. sample size was $2x75cm^2$. The biology *T. cinnabarinus* was conducted under laboratory conditions at room temperature. The adult mites were collected from the field and released on petridish. The leaf-disc technique was adopted for the purpose (Lall, 1977). In each Petridish female as well as male (2:1) adult mites were released on the dorsal surface of the leaf. On Each day all the stages of mites were transferred to fresh, excised leaf pieces taken from the same host plant species. Care was taken while transferring the mites to ensure that the injury caused to them was the minimum. For that a very fine and smooth camel hair brush (00) was used. A binocular microscope (10x) was used to record the observation and in transferring the mites to fresh leaves.

RESULTS

Seasonal Incidence: As the temperature started declining from November onwards the population started increasing reaching at peak during coldest month January-February. However during this period rainfall was zero (0.0mm.). From April-July only egg population was found. During this period temperature increased only moderately reaching at a maximum level of 34.17^{o}c. The ratio of the egg, immature and adult together was much higher on the dorsal surface (1:0.7) as compared to ventral surface (1:0.2) (Table 1) indicating thereby highest percentage of hatching and survival of various stages on the dorsal side.

Biology: The results of experiment conducted on the biology of Tetranychus cinnabarinus on papaya are presented in Table 3, Pre-oviposition period, Ovi-position period, Post-oviposition period was1.6±0.66days, 3.5±0.17days, and 1.6±0.33 days respectively.

Fecundity: Fecundity of it was 38.5±0.28 eggs .The earlier workers like Puttaswamy and Channabasavanna(1982) reported the fecundity as 149.40 eggs in case of *T. ludeni.* Manjunath and Puttaswamy(1989) on *T. neocaledonicus* reported this period to be 75.83± eggs. Therefore, the fecundity in the present observation was much less than the earlier findings.

Egg stage: Eggs are spherical and transparent when freshly laid but gradually turned creamy white and just before hatching two red spot like simple eyes are visible. The diameter of egg is 0.12 mm,The duration of egg stage was 6.1±0.16 and hatching percentage was 98.3-99.0.

Larva: The larva emerged out of the egg by making a slit in the chorion. Newly hatched larva is very small, slight globular in shape and white in colour with two prominent red spots on the dorsal propodosomal region. Duration of larval period was 4.1±0.17days which supported by the earlier findings of Manjunath and Puttaswamy (1989) in case of *T. neocaledonicus* (1.0-2.5) and Mallik and Channabasavanna (1981) in *T. ludeni* (32.5 hours). Length of larva 0.16mm, breadth 0.09mm and Ist,2nd,3rd pair of leg 0.14 mm,0.08mm and 0.09mm respectively.

Protonymph: Slight reddish in colour. The body of Protonymph is flattened dorso ventrally with black spots on the dorsal surface of the body. The length and breadth of the Protonymph was 0.24mm and 0.12mm and I^{st}, 2^{nd}, 3^{rd} and 4^{th} pair of leg was 0.09, 0.14, 0.13, 0.13 respectively. Protonymph possesses 4 pairs of legs covered with large number of setae of moderate length. The protonymph is active for a day. Protonymph then entered into a quiescent stage which lasted for 3.6±0.66days.

Deutonymph: Deutonymph differed from Protonymph mainly in the size of the body. It s deep reddish in colour. Female deutonymph is longer sized with flattened opisthosoma. Before moulting it passed through a quiescent stage which lasted for 3.8±0.17days. Length and breadth of the body and length of 1st to 4^{th} pair of leg was 0.36mm, 0.18mm, 0.24mm, 0.19mm, 0.17mm, 0.16mm respectively.

Male adult: The body is narrow and gradually tapering to the posterior region in a point and smaller than adult female. Males are more active than the female. The longevity of male lasted for 4.1±0.17days. Length and breadth of the body and 1st to 4th pair of leg was0.33mm,0.16mm,0.34mm, 0.24mm,0.22mm,0.28mm respectively.

Female adult: The adult female is dark red in colour, body is ovoid with brown spots on the dorsal surface. The legs are shorter than males. Length and breadth of the body, 1^{st} to 4^{th} pair of leg was 0.46mm, 0.27mm, 0.26mm, 0.23mm, 0.22mm and 0.19mm respectively. Longevity of female adult was 7.4±0.15 days. The total time required for development from egg to adult (in male) emergence was 15.7±0.11days and in female it was 17.6±0.66 days. The male adult emerged earlier than the female and was observed to place the earlier pair of legs of it and wait near the female deutonymph. Sometimes 3-4 males were surrounding a female deutonymph and were observed fighting aggressively by extending their chelicerae and pricking the other individuals. The male crawls head first under the posterior end of the moulting female and arched the end of his abdomen upward to accomplish the coupling. The female was held by the 2 pairs of fore legs of the male in the process. The number of eggs laid per day was reduced considerably with the female continuing to oviposit daily until she reached the post oviposition period.

Sex-ratio: The sex-ratio (Female: Male) of the mite species was found to be 1:0.47.So the sex-ratio appeared to be slightly female biased which supports the findings of Ghosal et al., (2006).

Mortality: Food plants might be influenced the death rate the mite population. Percentage of mortality showed 36.5±0.28%.

DISCUSSION

The Seasonal Incidence of *T. cinnabarinus* on the two surfaces of the leaves of papaya is presented in Table 1. It is evident from the data presented that mites were active through out the year, which is supported by Lall et al., (1965) and dorsal surface was almost invariably harboured higher population (91.9%), this is supports the similar evidence of Dhooria and.Bindra(1977),whereas it was lower in ventral surface(8.1%). Egg always outnumbered the immature and adult (Pande and Sharma 1985). The multiple correlations (Table 2) indicated that combined effect of temperature and rainfall significantly affected the mite population.

Table 1. Distribution of mite population

Mean nos./2x75cm^2 (percentage)				
Leaf surface	Egg	Immature and adult	Total Population	Ratio of egg and Immature & adult
Dorsal	88.6	97.1	91.9	1:0.7
ventral	11.4	2.9	8.1	1:0.2

Table 2. Correlation between stage-wise and total mite population* present on the dorsal surface of papaya leaves with the temperature and rainfall

Average population/2x75cm^2 leaf surface					
Months	Eggs	Immature& Adult	Total	Maximum v.Temp.(^{0}c)	Av.Rainfall(mm)
Feb,19	284.5	199.0	483.5	29.3	0.0
Mar,19	87.5	72.5	160.0	33.39	2.3
Apr,19	15.0	0.0	15.0	32.7	15.72
May ,19	8.5	0.0	8.5	34.17	10.89
Jun,19	1.5	0.0	1.5	32.05	25.06
Jul,19	8.0	0.0	8.0	32.24	16.72
Aug,19	19.0	8.5	27.5	35.63	11.08
Sept,19	13.0	3.5	16.5	.32.78	8.58
Oct,19	19.5	7.5	27	33.02	6.98
Nov,19	115.5	48.0	163	28.86	7.84
Dec,19	200.5	189.0	389.5	23.64	0.7
Jan,20	275.5	209.5	485.0	24.93	0.0
F calculated	64.69*	14.56*	74.16*	* Significant at 5% level	
't' test Temp.	4.06*	2.20*	4.30*	NS means Non significant.	
Rainfall	0.64(NS)	0.02(NS)	0.04(NS)		

*Based on 10 samples drawn from different fields in the 4 localities

Table 3: Biology of *Tetranychus cinnabarinus* on papaya leaf at room temperature (29.3 ^{o}c -33^{o}c)

Life stages	
Pre-oviposition period(days)	1.6±0.66*
Oviposition period(days)	3.5±0.17
Post-oviposition period(days)	1.8±0.33
Fecundity (nos.)	38.5±0.28
Egg stage(days)	6.1±0.16
Larval stage(days)	4.1±0.17
Protonymphal stage(stage)	3.6±0.66
Deutonymphal stage(days)	3.8±0.17
Adult stage(days)	
a)Male	4.1±0.17
b)Female	7.4±0.15
One complete life cycle(days)	
a)Male	15.7±0.11
b)Female	17.6±0.66
Sex ratio(Female: Male)	1:0.47
Mortality%	36.5±0.28

*Based on three replications

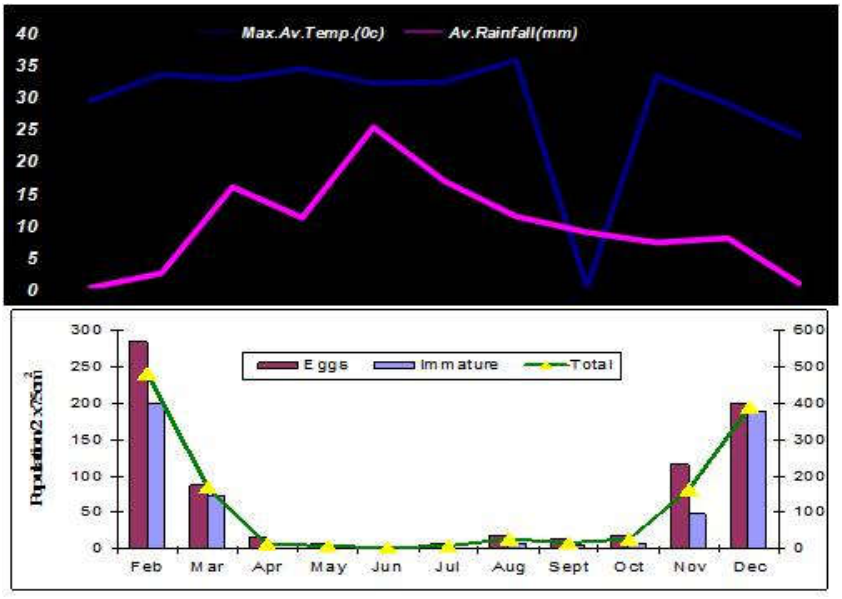

Fig. 1. Showing the effect of Temperature and Rainfall on the population of T. cinnabarinus during the survey period (February,2019 to January, 2020)

But analysis of single factor indicated that, rainfall did not change the population levels of both eggs and immature and adult combined together. Significantly negative co-relationship was established in case of temperature which is supported by Gupta et al. (1976). On this account 23^0c -29^0c was found to be the most preferable for mite population and above 30^0c results in the low population build up. The observations reported by other workers were 10.85 days in *T.ludeni* feeding on brinjal leaves (Puttaswamy and Channabasavanna 1981).

Conclusion

Mites of family Tetranychidae are considered as one of the important pests, even in moderate infestation greatly affects crop production and in heavy infestation cause death of the plants. Considering the importance of these pests, there is an urgent need to understand their seasonal activity and associated natural enemies

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