Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(3): 197-201

Received: 19-03-2019
Accepted: 23-04-2019

B Poovizhiraja
Department of Entomology, Agricultural College and Research Institute, Madurai, TNAU, Tamil Nadu, India

C Chinniah
Department of Entomology, Agricultural College and Research Institute, Madurai, TNAU, Tamil Nadu, India

M Murugan
Department of Entomology, TNAU, Coimbatore, Tamil Nadu, India

S Irulandi
Department of Fruit crops, Horticultural College and Research Institute, Periyakulam, TNAU, Tamil Nadu, India

K Eraivan Arutkani Aiyanathan
Dean, Agricultural College and Research Institute, Killikulam, TNAU, Tamil Nadu, India

TN Balamohan
Department of Horticulture, Agricultural College and Research Institute, Madurai, TNAU, Tamil Nadu, India

Correspondence
B Poovizhiraja
Department of Entomology, Agricultural College and Research Institute, Madurai, TNAU, Tamil Nadu, India

Impact of weather parameters on the population dynamics of major sucking pests of acid lime, *Citrus aurantifolia* Swingle

B Poovizhiraja, C Chinniah, M Murugan, S Irulandi, K Eraivan Arutkani Aiyanathan and TN Balamohan

Abstract
A field experiment was conducted to investigate the seasonal abundance of major sucking pests *viz.*, citrus blackfly, *Aleurocanthus woglumi* Ashby and citrus psyllids, *Diaphorina citri* Kuwayama on acid lime during September 2017 to August 2018. The influence of weather factors on population fluctuation of sucking pests in acid lime ecosystem was recorded that the occurrence of *A. woglumi* and *D. citri* were noticed throughout the study period 35th (1st week of September) to 34th (4th week of August) standard weeks. The population of *D. citri* attained first peak during 40th standard week (1st week of October) with 17.20 nymphs/ twig and its second peak during 19th standard week (2nd week of May) recording 17.40 nymphs/twig. The maximum population of *D. citri* could be observed during 34th standard week (4th week of August) with 24.50 nymphs /twig. Then the population of *A. woglumi* gradually increased and reached its first peak during 25th standard week (4th week of June) recording 67.70 nymphs/leaf. The sharp decline in *A. woglumi* population was noticed from 36th standard week (2nd week of September) and again started declining from 26th standard week (5th week of June) to 34th standard week (4th week of August). The correlation studies on the weather parameters with *D. citri* and *A. woglumi* population revealed that the maximum and minimum temperatures, relative humidity showed significant positive relationship with *D. citri*, where as rainfall exhibited non significant relationship with *D. citri* and *A. woglumi*. From the multiple linear regression analysis it is evident that among the weather factors, maximum and minimum temperatures, relative humidity had significant positive correlation with *D. citri* and *A. woglumi*, while rainfall exhibited non significant association with *D. citri* in acid lime ecosystem.

Keywords: Population dynamics, weather parameters, *Aleurocanthus woglumi* and *Diaphorina citri*

1. Introduction
Citrus fruit is rich sources of several nutrients such as fibres, carbohydrates and vitamins, minerals, which are essentially important for the maintenance of human health and growth. Acid lime is cultivated in almost all the states *viz.*, Tamil Nadu, Andhra Pradesh, Maharashtra, Karnataka, Gujarat and Himachal Pradesh. It is widely grown in the southern region of Tamil Nadu also. Citrus is commercially grown throughout India and occupies a place of prime importance among the major fruits of India, which ranks third after mango and banana. India is one of the principal citrus growing countries in the world in an area of 10.55 lakh hectares with the production of 127.46 lakh tonnes annually with the productivity of 9.90 tonnes per hectare [2]. In India, acid lime accounts for about 259,000 hectares with the production of 2,789,000 tonnes. In Tamil Nadu, acid lime occupies an area of 9,880 hectares with the production of 34,510 tonnes annually with the productivity of 3.49 tonnes per hectare [2].
In India, Citrus trees are reported to be damaged by several insects and mite species during different stages of crop [6], this causes fruit yield losses 83-95%. [19]. The Citrus blackfly, *Aleurocanthus woglumi* Ashby is considered as agriculturally important insect in several countries due to economic loss that it causes [4]. They suck the sap from the Phloem tissue of leaf and shoots, thereby removing the nutrients and possibly debilitating the plants by injecting toxic saliva [20]. It excretes copious amount of sugary honeydew, which coats leaf surface and fruit surfaces on which heavy growth of sooty mold saprophytic fungi (*Capnodium citri* Berk and Desm) will occur [17]. This fungus is known for growing thick and dark on the leaves results in reduced respiration and photosynthesis. Heavy infestations may cause fast deterioration of plants and yield reduction [10]. It has more than 300 host plants [17], of which citrus is the most preferred host for population buildup [16]. The most preferred host plant of

A. woglumi is the Tahiti lime (*Citrus latifolia*), when compared to sweet orange (*Citrus sinensis*) and mango (*Mangifera indica*) [18]. Fruit set is greatly reduced, losses caused by *A. woglumi* goes up to 80 per cent and more [9, 21].

Citrus psyllids, *Diaphorina citri* act as carriers of the bacteria *Candidatus liberibacter asiaticus* that cause fatal citrus disease (citrus greening) [11, 14]. *D. citri* is small sucking insect pest with mottled brown body which remains active from February to October with peak populations in spring and autumn seasons [12]. However, in the altered scenario of orchard management, there is a need to understand the comprehensive information regarding the pest complex and their seasonal abundance. Hence in the present study, investigations was undertaken to document the seasonal activity of pests in the acid lime ecosystem and to adopt a suitable control strategy to supports the insect pests under economic threshold level.

2. Materials and Methods

To study the Impact of abiotic factors on the population dynamics of sucking pests in acid lime ecosystem *viz*., citrus black fly, citrus psyllids were selected in hot spot area at Kumbakarai village of Periyakulam block, Theni district, Tamil Nadu during September 2017 to August 2018. Acid lime foliage of uniform age was selected @10 Nos per field which were tagged properly/ block and the populations of sucking pests were recorded at regular interval (once in week) in unprotected condition. The weather parameters *viz.*, Maximum and Minimum Temperature (ºC), Relative humidity (%), Rain fall (mm) were recorded from automatic weather station facility installed at Periyakulam block of Theni district for working out the correlation between weather parameters and populations dynamics of sucking pests in acid lime orchards in a given standard meteorological week. The data of population dynamics of citrus psyllids and citrus blackfly were subjected to correlation with different weather parameters and analyzed statistically by SAS 9.2 and SPSS 17.0 statistical software package to study influence of abiotic factors on fluctuations in population of citrus psyllids and citrus blackfly on acid lime.

3. Results and Discussion

To study the seasonal incidence of sucking pests in acid lime ecosystem in field condition, field with uniform aged bushes were selected at Kumbakarai village of Periyakulam block, Theni district, Tamil Nadu during September 2017 to August 2018. The possible influence of weather factors on population fluctuation of sucking pests in acid lime ecosystem was recorded at weekly intervals in fixed location. The study revealed that the occurrence of sucking pests of acid lime (Table 1) was noticed throughout the study period 35th (1st week of September) to 34th (4th week of August) standard week.

Initially the population of *D. citri* was low followed by gradually decreased from 6.50 to 17.20 nymphs/10cm length of twig (Table 1). And then the population of *D. citri* gradually increased as reached its first peak during 40th standard week (1st week of October) with 17.20 nymphs/twig. Thereafter the population of *D. citri* was started decreasing from 41st standard week (2nd week of October) to 50th standard week (3rd week of December). Again the *D. citri* population showed the increasing rate form 4th standard week (4th week of January) to 19th standard week (2nd week of May). Further, the *D. citri* population indicated an increasing rate of multiplication gradually which reached its second peak during 19th standard week (2nd week of May) recording 17.40 nymphs/twig. Subsequently there was a fluctuation in *D. citri* population from 4th standard week (4th week of January) to 34th standard week (4th week of August) and the maximum population could be observed during 34th standard week (4th week of August) with 24.50 nymphs /twig. During the present study period, two peaks could be noticed i.e. first peak during 40th standard week (1st week of October) and second peak coinciding with 19th standard week (2nd week of May). The results also revealed that there was a lot of oscillation in *D. citri* population from 4th January to 34th August standard week because of erratic distribution of weather factors, maximum and minimum temperatures, relative humidity and rainfall by which increasing and decreasing trend of *D. citri* population was observed (Figure 1). These results agree with the report of Hijam and Sharma [13] who revealed that *D. citri* population exihibited throughout the year but only adults found surviving during December and February. Two peaks of population (nymphs) were observed, 1st peak during April-May and 2nd peak during August-September. [5] Bhut *et al*. reported that the highest (1.52) *D. citri* nymphal population observed on different citrus groups during April and August.

The correlation studies (r) between weather parameters and *Diaphorina citri* population revealed that (Table 2) the maximum and minimum temperatures exhibited significant positive correlation (r = 0.66 and 0.66 respectively), while relative humidity had positively significant relationship (r = 0.39) with *D. citri* population, where as rainfall exhibited non significant relationship (r = 0.07) with *D. citri* in acid lime ecosystem. From the correlation analysis, it is evident that an increase in maximum and minimum temperatures by 1ºC resulted in an increase of *D. citri* population by 1.42 and 0.62 per cent, where as an increase in relative humidity by 1 per cent, there was an increase in *D. citri* population by 0.50 and while as an increase in rainfall by 1 mm, there was a decrease in *D. citri* population by 0.02 per cent, respectively. Multiple linear regression analysis (Table 2) was also carried out by taking into account *D. citri* population as dependent and weather parameters as independent variables. The results revealed that the coefficient of determination was significantly high (R^2 = 0.165), which implies that these weather factors *i.e.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall contributes directly towards the population buildup of *D. citri* in acid lime ecosystem to an extent of 16.5 per cent. From the multiple linear regression analysis it is clear that among the weather factors, maximum and minimum temperatures, relative humidity had significant positive relationship, while rainfall exhibited non significant association with *D. citri* in acid lime ecosystem. These finding fall in line with the repot of [3] Aruna *et al.*, who opined that the nymphal population of *D. citri* had significant positive correlation with maximum (r=0.47) and minimum temperature (r=0.46), non-significant correlation with rainfall (r=0.26) and non significant negative correlation with relative humidity. Correlation analysis indicated that maximum and minimum temperature, sunshine hours and rainfall were positively correlated with nymphal, adult and mixed population of *D. citri* but the effect of rainfall on adult population was non-significant, while relative humidity was negatively correlated [13].

Initially the population of *Aleurocanthus woglumi* was high followed by gradually decreased from 59.50 to 6.20

nymphs/leaf (Table 1). Then the population of *A. woglumi* gradually increased as reached its first peak during 25th standard week (4th week of June) recording 67.70 nymphs/leaf. The sharp decline in *A. woglumi* population was noticed from 36th standard week (2nd week of September) and again started declining from 26th standard week (5th week of June) to 34th standard week (4th week of August). There was lot of fluctuation in *A. woglumi* population from 36th standard week (1st week of September) to 34th standard week (4th week of August) and the minimum population could be observed during 2nd standard week (2nd week of January) with 6.20 nymphs/leaf. During the present study period, one peak was recorded, first peak during 25th standard week (4th week of June) (Figure 1). Similarly, [8] Correla observed that the population of *A. woglumi* peak activity was found during March to October. [15] Medeiros *et al.*, observed that the incidence of *A. woglumi* was distributed homogeneous on the tree canopies on the two locations. The highest population level of *A. woglumi* recorded during July - December.

The correlation studies (r) between weather parameters and *Aleurocanthus woglumi* population revealed that (Table 2) the maximum and minimum temperatures showed significant positive relationship (r = 0.69 and 0.72 respectively), while relative humidity and rain fall had a non significant relationship (r = 0.10 and 0.08 respectively) with *A. woglumi* population in acid lime ecosystem. From the correlation analysis, it is evident that an increase in maximum and minimum temperatures by 1ºC resulted in an increase of *A. woglumi* population by 2.33 and 3.33 per cent respectively, where as an increase in relative humidity by 1 per cent, there was an increase in *A. woglumi* population by 0.23 and while as an increase in rainfall by 1 mm, there was an increase in *A. woglumi* population by 0.10 per cent, respectively. Multiple linear regression analysis (Table 2) was also carried out by taking into account *A. woglumi* population as dependent and weather parameters as independent variables. The results revealed that the coefficient of determination was significantly high (R^2 = 0.595), which implies that these weather factors *i.e.*, maximum temperature, minimum temperature contributed directly towards the population buildup of *A. woglumi* in acid lime ecosystem to the extent of 59.50 per cent. From the multiple linear regression analysis it is evident that among the weather factors, maximum and minimum temperature had significant positive relationship with *A. woglumi*, while relative humidity with negative relationship with *A. woglumi* in acid lime ecosystem. Our findings are in conformity with the reports of [7] Chatterjee *et al.*, the incidence of citrus blackfly (*A. woglumi*) had a significant positive association with relative humidity and rainfall [1]. Anderson *et al.*, recorded that the temperature found positive and significantly correlation, while rainfall found significant negative correlated with the population of blackfly.

Table 1: Population dynamics of citrus psyllid, *Diaphorina citri* Kuwayama and citrus blackfly, *Aleurocanthus woglumi* Ashby in acid lime ecosystem (During September 2017- August 2018).

Standard meteorological weeks	Date of Observation	Psyllid No. of nymphs/10 cm length of twig	Blackfly No. of nymphs/ leaf	Standard meteorological weeks	Date of Observation	Psyllid No. of nymphs/10 cm length of twig	Blackfly No. of nymphs/ leaf
35	01 September2017	6.5	59.5	02 March 2018	09	2.2	39.1
36	08 September2017	8.3	53.1	09 March 2018	10	2.2	39.0
37	15 September2017	9.1	44.1	16 March 2018	11	4.4	42.0
38	22 September2017	9.5	36.4	23 March 2018	12	6.4	44.5
39	29 September 2017	12.4	30.6	30 March 2018	13	9.3	48.5
40	06 October 2017	17.2	25.1	06 April 2018	14	11.2	49.1
41	13October 2017	15.6	27.3	13 April 2018	15	12.3	51.0
42	20 October 2017	11.0	32.4	20 April 2018	16	15.6	52.2
43	27October 2017	8.1	33.2	27 April 2018	17	16.5	53.8
44	03 November2017	4.4	35.4	4 May 2018	18	16.9	54.4
45	10 November2017	2.0	40.3	11 May 2018	19	17.4	54.5
46	17 November2017	2.0	38.1	18 May 2018	20	15.1	54.8
47	24 November 2017	1.0	32.7	25 May 2018	21	13.3	56.2
48	01 December 2017	0.9	27.7	1 June 2018	22	10.5	57.0
49	08 December 2017	0.9	21.6	8 June 2018	23	9.8	60.4
50	15 December 2017	0.6	17.1	15 June 2018	24	7.7	65.1
51	22 December 2017	0.0	11.0	22 June 2018	25	5.1	67.7
52	29 December 2017	0.0	9.6	29 June 2018	26	7.8	62.4
01	05 January2018	0.0	6.2	06 July 2018	27	9.4	58.4
02	12 January2018	0.0	6.2	13 July 2018	28	11.4	50.6
03	19 January2018	0.0	8.6	20 July 2018	29	15.6	46.1
04	26 January2018	0.6	12.1	27 July 2018	30	16.3	44.3
05	02 February 2018	1.4	16.1	03 August 2018	31	16.9	39.8
06	09 February 2018	1.4	22.4	10 August 2018	32	20.1	36.4
07	16 February 2018	1.8	28.3	17 August 2018	33	23.7	35.1
08	23 February 2018	2.0	34.7	24 August 2018	34	24.3	31.7

Table 2: Correlation and multiple linear regression models for weather parameters on Population dynamics of *D. citri* and *A. woglumi* in acid lime ecosystem (During September 2017- August 2018).

Populations	Correlation Coefficient value				Multiple linear regression equation value	Coefficient of determination
	Maxi. Temperature (^{0}C)	Mini. Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)		
	(X1)	(X2)	(X3)	(X4)	(Y)	(R^2)
Diaphorina citri Kuwayama	0.665**	0.669**	0.391**	0.077	$Y= -87.14+1.42X_1+0.62X_2+0.50X_3-0.02X_4$	0.165
Aleurocanthus woglumi Ashby	0.690**	0.720**	0.103	0.085	$Y= -104.81+2.33X_1+3.33X_2\ 0.23X_3+0.01X_4$	0.595

**Significant at 1% Probability

*Significant at 5% Probability

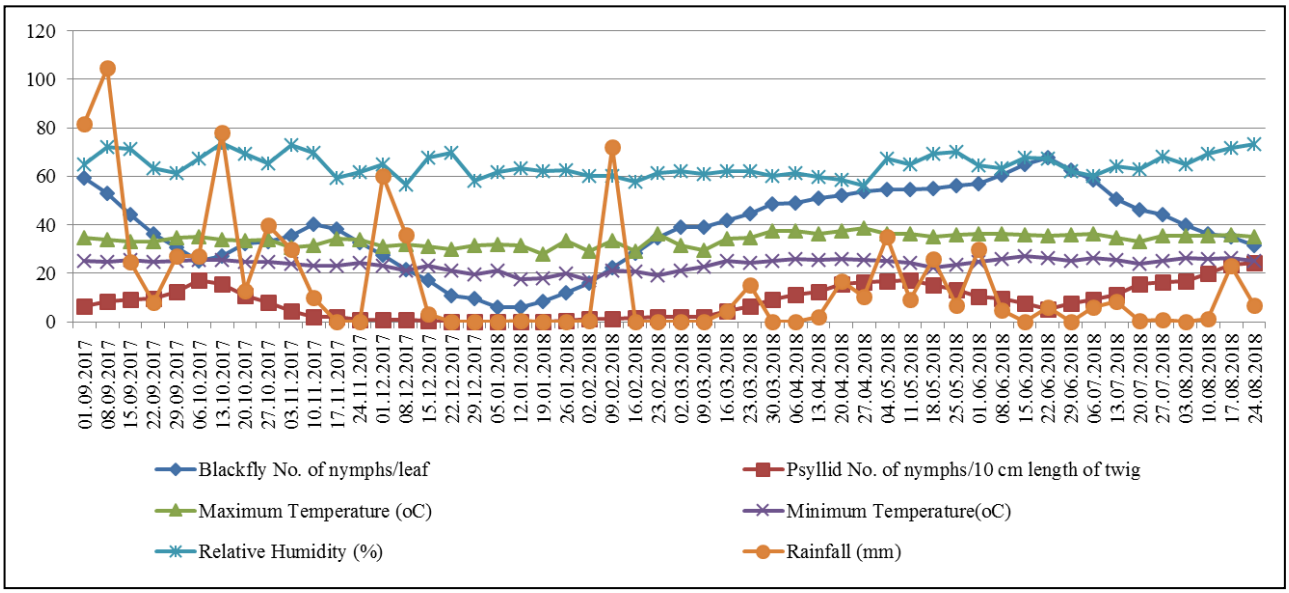

Fig 1: Population dynamics of citrus psyllid, *Diaphorina citri* Kuwayama and citrus blackfly, *Aleurocanthus woglumi* Ashby in acid lime ecosystem relation with weather parameters (During September 2017- August 2018).

4. Conclusion

The population of *D. citri* and *A. woglumi* reached its first peak during 40th standard week (1st week of October) with 17.20 nymphs/ twig and during 25th standard week (4th week of June) recording 67.70 nymphs/leaf. The maximum and minimum temperatures showed significant positive relationship, while relative humidity and rain fall had a non significant relationship with *D. citri* and *A. woglumi* population in acid lime ecosystem.

5. References

1. Anderson GD, Arlindo BJ, Farias RS, Barbosa JC. Infestation of citrus black fly in citrus orchards conventional and agroforestry. Rev. Bras. Frutic. Jaboticabal. 2011; 33(1):53-60.
2. Anonymous. Horticultural Statistics at a Glance. Horticulture Statistics Division, Government of India. 2017, 15-427.
3. Aruna J, Jagginavar SB, Karabhantanal SS, Shalini N. Huilgol. Seasonal abundance of citrus psyllid, *Diaphorina citri* kuwayama on acid lime. J. Exp. Zool. India. 2017; 20:1511-1513.
4. Batista TFC, Rodrigues RC, Ohashi OS, Santos MMdeLS, Oliveira FCde, Soares ACS *et al*. Identificação de fungos entomopatogênicos para controle da mosca negra dos citros *Aleurocanthus woglumi* Ashby (Hemiptera: Aleyrodidae). Praga quarentenária. Available at: http://www.ufpel.tche.br/sbfruti/ anais_xvii_cbf/ fitopatologia/706.htm. 2002. [Review date: 26 March 2010].
5. Bhut GD, Borad PK, Gadhiya VC. Effect of weather parameters on activity of psylla and leaf- miner on kagzi lime. AGRES -An International e-Journal. 2013; 2(1):101- 107.
6. Butani DK. Insect pests of citrus and their control. Pesticides. 1979; 13(4):15-21.
7. Chatterjee H, Ghosh J, Senapati SK. Influence of important weather parameters on population fluctuation on major insect pest of mandarin orange (*Citrus reticulata* Blanco) at Darjeeling district of West Bengal (India). J. Ento. Res. 2000; 24(3):229-233.
8. Correla RG. First record of occurance of *Aleurocanthus woglumi* Ashby in Roraima. Revista Agroambiente. 2011; 5(3):245-248.
9. Eberling W. Subtropical Entomology (2nd edition). Lithotype Process Co., San Francisco, USA. 1954, 505-508.
10. Fasulo TR, Brooks RF. Whitefly pests of Florida citrus. Gainesville: Department of Entomology and Nematology (ENY, 815), 1993. Available at: http://edis.ifas.ufl.edu. [Review date: 21 January 2010].
11. Halbert SE, Manjunath KL. Asian citrus psyllids (Sternorryncha: Psyllidae) and greening disease of citrus: a literature review and assessment of risk in Florida. Florida Entomologist. 2004; 87:330-53.
12. Hall DG, Richardson ML, Ammar ED, Halbert SE. Asian citrus psyllid, *Diaphorina citri* (Hemiptera: Psyllidae), vector of citrus huanglongbing disease. Entomol. Exp. Appl. 2013; 146:207-223.
13. Hijam SD, Sharma DR. Impact of abiotic factors on build-up of citrus psylla, *Diaphorina citri* Kuwayama population in Punjab, India, J. Appl. Natu. Sci. 2014; 6(2):371-376.
14. Mahmood R, Rehman A, Ahmad M. Prospects of biological control of citrus insect pests in pakistan. J. Agric. Res. 2014; 52(2):229-244.
15. Medeiros FR, Raimunda N, Santos D. Populational Dynamics of Citrus Blackfly, *Aleurocanthus Woglumi* Ashby (hemiptera: Aleyrodidae) in Citrus spp. in Sao Luis, Maranhao, Brazil, Bra. Mag. Fru. Cul. 2009; 31(4):1016-1021.
16. Nguyen R, Hamon AB. Citrus Blackfly, *Aleurocanthus woglumi* Ashby (Homoptera: Aleyrodidae). Gainesville: DPI Entomology (Circular, 360), 1993; Available at: edis.ifas.ufl.edu/ ch114. [Review data: 20 May 2010].
17. Oliveira MRV, Silva CCA, Návia D. Praga quarentenária A1 a mosca-negra-dos-citros, *Aleurocanthus woglumi* Ashby (Hemiptera: Aleyrodidae). Brasilia: Ministério da Agricultura, Pecuária e Abastecimento, 1999.
18. Pena MR, Vendramim JD, Lourenção AL, Silva NM, Yamamoto PT, Gonçalves MS. Ocorrência da moscanegra-doscitros, *Aleurocanthus woglumi* Ashby

(Hemiptera: Aleyrodidae) no estado de São Paulo. Rev Agro. 2008; 83:61-65.
19. Randhava GS. Horticulture - Importance of pest control. Pesticides Annual. 1974; 8:85-87.
20. Silva AG, Farias PRS, Boiça Junior AL, Souza BHS. Mosca-Negra-dos-Citros: Características Gerais, Bioecologia e Métodos de Controle dessa Importante Praga Quarentenária da Citricultura Brasileira. Entomol Brasilis. 2011; 4:85-91.
21. Yamamoto PT, Lopes S, Bassanezi RB, Belasque JrJ, Sposito MB. Citros: estrago à vista. Cultivar Hortaliças e Frutas. 2008; 8:22-24.