Egypt. J. Plant Prot. Res. Inst. (2020), 3 (3):896 - 905

Egyptian Journal of Plant
Protection Research Institute
www.ejppri.eg.net

Bionomics of the jasmine whitefly *Dialeurodes kirkaldyi* (Hemiptera: Aleyrodidae) in Egypt as well as seasonal abundance of this pest and its parasitoid on jasmine

EL-Amir, S. M. ; Abd El-Mageed, S. A. M. and Shaaban, Abd-Rabou
Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

ARTICLE INFO
Article History
Received: 16/7/2020
Accepted: 21 /9/2020

Keywords
Bionomics, jasmine whitefly, *Dialeurodes kirkaldyi* , seasonal abundance, *Eretmocerus corni* , jasmine and Egypt.

Abstract:

Jasmine is one of the oldest traditional flowers and it is an important flowering group of plants which are commercially grown for their fragment flowers and oil production. The jasmine whitefly *Dialeurodes kirkaldyi* (Kotinsky) (Hemiptera: Aleyrodidae) is one of the most important pest of jasmine all over the world and Egypt. Larvae and adults of this pest suck the sap from the under surface of the leaves and infested leaves turn yellow. The aim of this work is to study the bionomics of *D. kirkaldyi* as well as seasonal abundance of this pest and its parasitoid on jasmine plant . The results indicated that *D. kirkaldyi* infested by 12 host plants distributed in 9 Governorates and recorded associated with 4 parasitoids in Egypt as well as taxonomy studies of it was provided.It also was found infesting jasmine plants at Gharbiya Governorate, Egypt. To obtain basic ecological data for the whitefly , D. kirkaldyi and its parasitoid *Eretmocerus corni* Haldeman (Hymenoptera: Aphelinidae) every two weeks intervals throughout two seasons (August to December 2018 and 2019). Seasonal fluctuations of alive total population, nymphs and adults of *D. kirkaldyi* throughout the tested year. The seasonal abundance for both nymph and adult recorded one peak on middle of October in two seasons. The effects of four ecological factors (3 abiotic +1 biotic) on the population dynamics of alive larvae and adult population were estimated. The parasitoid *E. corni* showed highly significant correlation with larvae of *D. kirkaldyi* by (r= 0.91 and 0.92) in two seasons.

Introduction

Jasmine products are important natural raw materials in the perfume industry. Jasmine flowers are used for making gariands for ceremonial offering, for adoring hair by ladies and for production of "attar" and concrete in cosmetic industry. These flowers are also used in toiletries, food essences, chewing tobacco, dental preparations and confectioneries. Even different parts of the plants such as leaf, stem, bark, root and fruits are also used for medicinal purposes (Guledagudda *et al.*,1997) . Jasmine trade is estimated to pull in some $6.5 million annually for Egypt, providing income to around 50,000 people, according to the International Federation of Essential

Oils and Aroma Trades (AFP, 2020). Jasmine is infested by several insect and mite pests. The lepidopteran pests like bud borer, *Hendecasis duplifascialis* (Hampson) (Crambidae; Lepidoptera); bud borer/gallery worm, *Elasmopalpus jasminophagus* (Hampson) (Pyralidae: Lepidoptera), and leaf webworm, *Nausinoe geometralis* (Guenee) (Crambidae; Lepidoptera) are of major importance. Sucking pests like eriophyid mite, *Eryophes* spp (Acarina: Eriophyidae); tingid bug, *Corythauma ayyari* (Drake) (Hemiptera: Tingidae); whitefly, *Dialeurodes kirkaldyi* (Kotinsky) (Hemiptera: Aleyrodidae) and flower thrips, *Isoneurothrips orientalis* (Bagn.) (Thysanoptera: Thripidae) cause minor damage to the crop. Dipteran pest like blossom midge, *Contarinia maculipennis* Fabricius (Diptera: Cecidomyiidae) sometimes infests the crop (Pal and Chakravarthy, 2020). The most important pests are whiteflies, specially in the Mediterranean region, so it is attacked by 16 species of whiteflies ; These are *Aleuroclava jasmini* (Takahashi), *Aleurodicus dispersus* Russell , *Aleurolobus bidentatus* Singh, *Aleurothrixus* sp. , *Aleurotrachelus trachoides* (Back) , *Bemisia giffardi* (Kotinsky) , *Bemisia jasminum* David & Subramanian , *Bemisia tabaci* (Genn.) , *Dialeurodes citri* (Ashmead), *Dialeurodes kirkaldyi* (Kotinsky) , *Dialeurodes* sp. , *Dialeurodes vulgaris* Singh, *Minutaleyrodes minutus* (Singh) , *Singhiella citrifolii* (Morgan), Singhius hibisci (Kotinsky) and *Trialeurodes vaporariorum* (Westwood) . The dangerous pest of them is *D. kirkaldyi* (Hemiptera: Aleyrodidae). The several biotic and abiotic factors are responsible for low productivity and quality deterioration of jasmine production, but the damage caused by multitudes of arthropod pests constitutes the most important limiting factor. To overcome these pests, the above mentioned IPM measures can be successfully imposed wherever applicable for the management of pests in jasmine. The minimum yield loss caused by these pests can even be avoided (Rabeena *et al*., 2020).

D. kirkaldyi has a history of spreading internationally. It was first described in 1907 on *Jasminum grandifolium* from Hawaii (Kotinsky, 1907), although the area of origin of the species is uncertain (Martin *et al*., 2000). The nymphs and adults of whitefly suck the sap from lower surface of the leaves in large numbers and cause yellowing. It invites sooty mould fungus thereby photosynthesis will be affected and reduction in yield occurs (Rabeena *et al*., 2020).

It attacked by different host plant species in Egypt and the world by Abd-Rabou (1996 and 1997) , Evans (2007) and Sundararaj and Dubey (2006). *D. kirkaldyi* is a widely distributed species that is found on (Russell , 1964; Sundararaj and David , 1992; Evans, 2007 and Chiun-Cheng *et al*., 2010). Also is a mainly tropical and sub-tropical oligophagous whitefly of relatively little importance to UK Plant Health. Its main hosts are *Jasminum* species. It is already present in the EU (Portugal and Cyprus) (Mifsud *et al*., 2010).

As a potential pest of citrus, southern EU MS should be aware of this organism. It is likely to spread within the Mediterranean region. Citrus producing regions should monitor the scientific literature for further information on this organism. The most favoured hosts, on which high numbers of *D. kirkaldyi* can be found, are *Jasminum* spp. and *Morinda citrifolia* (Evans and Bennett, 1996 and Martin *et al*., 2000). Also, it was found on several species of host plants in Florida,

including citrus, but high populations of this whitefly are only known to occur on jasmine species (Nguyen *et al.*, 1993).

However, immature stages and adults do cause damage by feeding on plant sap (Nguyen and Hamon, 1989). Larvae and adults of this pest suck the sap from the under surface of the leaves and infested leaves turn yellow and is associated with vectoring yellow ring mosaic disease of jasminum (Mariappan and Ramanujam, 1975 and Mound, 1983).

Nguyen *et al.* (1993) and Polaszek *et al*. (1999) recorded one parasitoid species, *Encarsia protransvena* Viggiani (Hymenoptera: Aphelinidae), has been reported from *D. kirkaldyi.* Evans and Bennett (1996) recorded *Eretmocerus rosei* Evans and Bennett for the first record of an *Eretmocerus* species that has been reared from this whitefly species, and only the second record of an *Eretmocerus* species that attacks this whitefly genus. Denmark (1964) reported on the introduction of an undetermined species of the genus *Eretmocerus* into Florida as a natural enemy of the citrus whitefly *Dialeurodes citri* (Ashmead).

Eretmocerus corni Haldeman (Hymenoptera: Aphelinidae) is one of the most important parasitoids associated with whitefly species and first recorded in Egypt by Priesner and Hosny (1940). It is recorded associated with 16 host whitefly and 14 countries of the world and 3 whitefly species in 6 Governorates in Egypt (Abd-Rabou, 1998c). The three whitefly hosts, *B. tabaci* , *Siphoninus phillyreae* (Haliday) and *Trialeurodes ricini* (Misra). In 1998, Abd-Rabou and Abou-Setta recorded seven parasitoids attacking *S. phillyreae* one of them *E. corni*. Also, Abd-Rabou (1998 a,b,c and 2002) recorded this species associated with *B. tabaci* and *T. ricini*.

The aim of this work is to study the taxonomy, host plants , distribution and parasitoids of *D. kirkaldyi* as well as seasonal abundance of this pest and its parasitoid on jasmine plant .

Materials and methods

1. Survey of host plants, distribution and parasitoids of the jasmine whitefly *Dialeurodes kirkaldyi*:

A survey of the jasmine whitefly *D. kirkaldyi* host plants , distribution and parasitoids were carried out in different locations in Egypt throughout two successive years. Samples of infested leaves and branches with *D. kirkaldyi* . The samples were packed in paper bags and transferred to the laboratory for examination. The examined leaves were enclosed in plastic jars covered with muslin held in position by a rubber band and kept under preferential conditions for securing any emergence of parasitoids. The parasitoids were collected, sorted into species and preserved in vials contain 70 % ethyl alcohol and glycerin, in addition to slide mounting species for identification.

2. Seasonal abundance of the jasmine whitefly *Dialeurodes kirkaldyi*:

It was carried out for 2 years, (August till December ,2018 and 2019) at Gharbiya Governorate, Egypt. A farm about one Fadden in area, cultivated with jasmine and heavily infested with *D. kirkaldyi* was chosen for this study. The farm was not exposed to any chemical treatment during three years prior to the present study and during the investigation period. Every15 day-intervals 30 leaves with different stages of the whitefly, *D. kirkaldyi* were collected at random from the different directions of jasmine plant. The leaves represented the different sides, peripheral, inner zones, lower and middle of the plant. These leaves were kept in a paper bag and transferred to the laboratory for examination and

counting the whitefly insects. The stages of whitefly insect considered in counting process were larval instars and adults .

3. Seasonal abundance of the parasitoid *Eretmocerus* corni associated with the jasmine whitefly *Dialeurodes kirkaldyi*:

Jasmine leaves infested with larval instars of *D. kirkaldyi* were half monthly ,(30 leaves /15 days) from August till December ,2018 and 2019. Each leaf was stored in well-ventilated glass emergence tube for its parasitoid emergence that its numbers were recorded daily was calculated. Samples 30 leaves randomly selected whitefly were chosen. These samples represented larval instars, . Each larval whitefly was removed, transferred and mulched on a slide in a water film.

4. Effect of biotic and abiotic factors on the abundance the jasmine whitefly *Dialeurodes kirkaldyi*:

Weather factors as maximum, minimum temperature and relative humidity were considered from Central Laboratory for Agricultural Climate. The weekly maximum and minimum temperatures as well as relative humidity were calculated and total number of parasitiods. Multiple regressions were conducted for weather factors combined as well as plant age as described. The obtained determination factor (R^2) of E.V. % was used to explain the effect of testing factors. Process Correlation and Regression were used in SAS to analysis the obtained date **(SAS Institute, 1998).**

Results and discussion

1. Taxonomy of *Dialeurodes kirkaldyi:*

1.1. Order: Hemiptera

Suborder : Sternorrhyncha

Superfamily: Aleyrodoidea

Family : Aleyrodidae

Genus *: Dialeurodes*

Species: *kirkaldyi*

1.2. Genus *Dialeurodes* Cockerell

1.2.1.Synonyms :

Aleyrodes (Dialeurodes) **Cockerell 1902**: 283. Type species. *Aleyrodes citri* Riley and Howard 1893, by original designation, a synonym of *A. citri* Ashmead 1885.

Dialeurodes Cockerell; full genus, **Quaintance and Baker 1914**: 97.

Kanakarajiella David and Sundararaj 1993. Type species. *Dialeurodes vulgaris* Singh 1931, by original designation; synonymy according to Martin and Mound 2007: 28.

Lankaleurodes **David 1993: 23**. Type species. *Dialeurodes radiipuncta* Quaintance and Baker 1917, by original designation; synonymy according to **Martin and Mound 2007: 28.**

Shanthiniae David 2000, in P.M.M. **David 2000: 125**. Type species - *Shanthiniae sheryli* David 2000, by monotypy and original designation; synonymy according to **Martin and Mound 2007: 28.**

Dialeurodes (*Rabdostigma*) **Quaintance and Baker 1917: 426**, *Dialeurodes* (*Gigaleurodes*) Quaintance and Baker 1917: 426, and *Dialeurodes* (*Dialeuroplata*) **Quaintance and Baker 1917: 435**

Dialeuronomada Quaintance and Baker; full genus by Sundararaj and David, 1991.

1.2.2. Diagnostic characters:

Pupal case dark brown or yellowish, puparial outline not laterally indented abdominally ; puparial margin smooth, or more coarsely crenulate. Thoracic and caudal tracheal openings at margin in form of distinct invaginated pores which are smooth or finely crenate internally. Vasiform orifice relatively small, subcircular posterior margin often with small median tubercle. Operculum usually concealing lingula. Inner margins toothed or smooth.

1.2.3. Key to Genus *Dialeurodes* members in Egypt:

1. Subdorsal setae not extending beyond margin of pupal case. Anterior rim short, length about one-eighth of length of vasiform orifice……...*Dialeurodes elbaensis* Priesner & Hosny

-Subdorsal setae different. Anterior rim long…..……2

2. 1st abdominal setae present. A brown area, in the median area of the dorsum. The margin of vasiform orifice without median tubercle posteriorl..*Dialeurodes kirkaldyi* (Kotinsky)

-1stabdominal setae absent. No brown area in the median area of the dorsum. The margin of vasiform orifice with median tubercle posteriorly*Dialeurodes citri* (Ashmead)

1.3. *Dialeurodes kirkaldyi* (Kotinsky)

1.3.1.Synonyms :

Aleyrodes kirkaldyi Kotinsky **1907: 95-96.** Syntypes. USA: Hawaii, on unidentified trailing shrub. *Beaumontia grandifolia*, *Morinda citrifolia* and *Jasminum grandiflorum*, USNM.

Dialeurodes kirkaldyi (Kotinsky); **Quaintance and Baker 1914: 98.**

Dialeurodes yercaudensis **Jesudasan and David 1991: 307.**

1.3.2. Dignostic characters:

Median line of puparium often pigmented brownish (examine several); A brown area, in the median area of the dorsum; first abdominal setae present but very small ; eighth abdominal setae opposite, or posterior to, widest part of operculum . The margin of vasiform orifice without median tubercle posteriorly, vasiform orifice toothed; pale species with median thoracic pigmentation. Submarginal setae absent.

2. Host plants of *Dialeurodes kirkaldyi*:

2.1. In Egypt : Combretaceae: *Terminalia* sp., *Terminalia chebula.* Covolvulaceae: *Convolvulus arvensis.* Malvaceae: *Malva rotundifolia*, *Malva silvestri.* Myrtaceae: *Pisdium guava.* Oleaceae: *Jasminum grandiflorum*, *Jasminum officinale*, *Jasminum sambac.* Ranuculaceae: *Ranuculus repens.* Rubiaceae: *Coffea* sp., *Coffea arabica.*

2.2.In World: Apocynaceae: *Allamanda neriifolia*, *Beaumontia grandiflora*, *Plumeria acuminata*, *Plumeria acutifolia*, *Tabernaemontana* sp., *Trachelospermum jasminoides*; Combretaceae: *Terminalia* sp.; Ebenaceae: *Diospyros kaki*, Ebenaceae: *Diospyros* sp., *Diospyros virginiana*; Geraniaceae: *Pelargonium* sp.; Jugandaceae: *Juglans regia*; Lauraceae: *Persea americana*; Loganiaceae: *Fagraea fragrans*; Lythraceae: *Lagerstroemia indica*; Malpighiaceae: *Hiptage benghalensis*, *Hiptage madablota*; Malvaceae: *Malva sylvestris*; Oleaceae: *Jasminum amplexicaule*, *Jasminum arabica*, *Jasminum auriculatum*, *Jasminum biflorum*, *Jasminum multiflorum*, *Jasminum nitidum*, *Jasminum officinale*, *Jasminum sambac*, *Jasminum volubile*, Oleaceae: *Jasminum frutiscens*, *Ligustrum walkeri*, *Syringa* sp.?; Rubiaceae: *Coffea arabica*, *Coffea* sp., *Gardenia tahitiensis*, *Jasminum sambac*, *Morinda citrifolia*, *Morinda royoc*; Rutaceae: *Citrus sinensis*, *Citrus x paradisi*; Verbenaceae: *Clerodendrum fragrans*, *Premna integrifolia*.

3. Distribution of *Dialeurodes kirkaldyi* :

3.1. In Egypt: Alexandria, Assiut, Aswan, Cairo, Gharbiya, Giza, Ismailia, Portsaid and Qalyubiya.

3.2. In World: Australia, Azores, Bahamas, Barbados, Burma, Caroline Is., China, Cook Is., Costa Rica, Cuba, Egypt, Fiji, Ghana, Greece, Guam, Guyana, Hawaii, Hong Kong, India, Iran, Israel, Jamaica, Japan, Lebanon, Malaysia, Mexico, Pakistan, Philippines, Puerto Rico, Samoa, Sri Lanka, Syria, Tahiti, Taiwan, Thailand, Trinidad, Turkey, UK, USA.

4.Parasitiods of *Dialeurodes kirkaldy :*

4.1. In Egypt: Aphelinidae: *Encarsia lutea* (Masi) **,** *Encarsia protransvena* Viggiani, *Eretmocerus corni* Haldeman and *Eretmocerus mundus* (Mercet).

4.2. In World: Aphelinidae: *Encarsia abundantia* Chou & Su, *E. bothrocera* Huang and Polaszek, *E. dialeurodis* Hayat, *E. lahorensis* (Howard) , *E. lutea* (Masi), *E.neoporteri* Myartseva and Evans , *E. nigricephala* Dozier, *E. perflava* Hayat, *E. protransvena* Viggiani, *Encarsia* sp., *E. strenua* (Silvestri) , *E.strenua* group, *E. tabacivora* Viggiani,, *Eretmocerus portoricensis* Dozier, *Er. rosei* Evans and Bennett, *Eretmocerus* sp.

5. Seasonal abundance of the jasmine whitefly Dialeurodes kirkaldyi:

Data presented in, (Tables 1 and 2) illustrated that larvae and adults stages curves had one peak during the first year, (2018) and the second year (2019) on jasmine leaves. In the first year, (2018) the peak of larvae recorded on (15^{th} of October) with 1019 individuals (30 leaves) and the peak of adult recorded on (15^{th} of October), with 422 individuals (30 leaves). While in the second year (2019) the peak of larvae also, recorded on (15^{th} of October) with 1028 individuals (30 leaves) and the peak of adult recorded on (15^{th} of October), with 430 individuals (30 leaves). **Helmi (2005)** *D. kirkaldyi* had three annual field generations which lasted 170, 90 and 100 days, respectively.

6. Seasonal abundance of the parasitoid *Eretmocerus corni* associated with the jasmine whitefly *Dialeurodes kirkaldyi*:

The parasitoid *E. corni* is an effective parasitoid which keeps populations of the *D. kirkaldyi* under control in Egypt. In the first year (2018) and the second (2019),the highest peak was observed in 15th of October in two years (Tables 1 and 2). The parasitoid *E. corni* showed highly significant correlation with larvae of *D. kirkaldyi* by (r= 0.91 and 0.92) in two seasons.

7. Effect of biotic and abiotic factors on the abundance of *Dialeurodes kirkaldyi:*

We studied the effect of a biotic factor as parasitoid (Biotic) and abiotic factors maximum, minimum temperature and relative humidity. Correlation, regression analysis and multi regression between biotic and abiotic factors and population of *D. kirkaldyi* was in liner degree, in two years of study 2018 and 2019. Statistically, the results represented in Table (3) showed the effect of the weather factors (maximum, minimum temperature and relative humidity) activity of *D. kirkaldyi.* With the respect to abiotic factors had significant effect on the population of the larval stage of *D. kirkaldyi* in two years of study, while adult had significant effect on the population with maximum temperature in two years of study 2018 and 2019 (Tables 1 and 2). El-Borollosy *et al.* (1990) tested the effect of maximum and mean temperature as well as mean percentage of relative humidity on *D. kirkaldyi* abundance they stated that these three factors had influence on the population density of this whitefly species, this influence differed significantly from one influence on the population density of this whitefly species, this influence differed significantly from one weather factor to another and from one season to another. Later Helmi (2005) obtained results of statistical analysis for the effects of some ecological factors on the population dynamics of *D. kirkaldyi* nymphs revealed that maximum, minimum and mean temperature had high positive significant effects on nymph seasonal. While mean percentage of relative humidity had positive insignificant effects.

Table (1) : Total population the jasmine whitefly *Dialeurodes kirkaldyi* and number of its parasitoid *Eretmocerus corni* on jasmine at Gharbiya Governorate during the first year 2018.

Date	Mean number of *Dialeurodes kirkaldyi*		Mean number of *Eretmocerus corni*	Climatic Factors		
	larvae	Adults		Max. Temp. °C	Min. Temp. °C	Mean RH.%
1 August	650	212	187	35.4	22.6	58.1
15-Aug	813	419	199	35.2	21.9	58.8
1 Sep.	939	390	243	33.8	21.3	61.5
15 Sep.	963	399	260	33.9	20.8	62.7
1 Oct.	995	412	322	31.4	19.7	62.1
15 Oct.	1019	422	436	30.2	18.8	63.1
1 Nov.	643	271	302	27.1	17.7	61.8
15 Nov.	635	268	232	26.1	16.4	57.3
1 Dec.	543	231	101	21.0	15.0	58.3
15 Dec.	553	235	15	18.3	14.1	57.0

Table (2): Total population the jasmine whitefly *Dialeurodes kirkaldyi* and number of its parasitoid *Eretmocerus corni* on jasmine at Gharbiya Governorate during the second year 2019.

Date	Mean number of *Dialeurodes kirkaldyi*		Mean number of *Eretmocerus corni*	Climatic Factors		
	Larvae	Adults		Max. Temp. °C	Min. Temp. °C	Mean R.H.%
1 August	701	190	175	35.8	20.7	59.7
15-Aug	822	428	207	35.7	22.7	59.6
1 Sep.	948	398	251	35.4	21.1	60.5
15 Sep.	971	408	269	33.7	20.7	61.7
1 Oct.	1004	421	330	34.1	19.9	62.7
15 Oct.	1028	430	444	31.6	18.9	63.9
1 Nov.	651	280	310	28.6	17.5	62.1
15 Nov.	644	277	240	27.4	16.2	58.5
1 Dec.	551	240	109	26.1	15.1	59.1
15 Dec.	561	244	20	20.4	14.6	60.6

Table (3) : The simple correlation and regression coefficients and multiple regressions between the different stages of *Dialeurodes kirkaldyi* , climatic factors and *Eretmocerus corni* in 2018 and 2019 years.

Factors		Simple correlation and regression						Multiple regression	
		R		P		B		E.V %	
		2018	2019	2018	2019	2018	2019	2018	2019
larvae	**Max. Temp. °C**	0.67	0.71	0.036	0.022	21.2	26.1	79.58	80.77
	Min. Temp. °C	0.60	0.71	0.068	0.021	38.6	48.4		
	Mean R.H.%	0.82	0.66	0.003	0.038	66.0	72.3		
	Eretmocerus corni	0.75	0.75	0.012	0.012	1.2	1.2		
	All above							80.05	82.12
Adults	**Max. Temp. °C**	0.59	0.53	0.072	0.112	8.8	9.7	63.78	59.23
	Min. Temp. °C	0.52	0.61	0.126	0.059	15.6	20.8		
	Mean R.H.%	0.72	0.55	0.020	0.101	26.8	29.8		
	Eretmocerus corni	0.65	0.65	0.043	0.043	0.5	0.5		
								66.83	69.62

References

Abd-Rabou, S. (1996): Egyptian Aleyrodidae, Acta Phytopathologica et Entomologica Hungarica, 31 (3-4): 275-285.

Abd-Rabou, S. (1997): Hosts, distribution and vernacular names of whiteflies (Homoptera: Aleyrodidae) in Egypt. Annals of Agric. Sci., Moshtohor, 35 (2): 1029-1048.

Abd-Rabou, S. (1998a): Parasitoids of *Bemisia tabaci* (Genn.) (Hom. Aleyrodidae) in Egypt. Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri', Portici, 54:11-16

Abd-Rabou, S. (1998b): The efficacy of indigenous parasitoids in the biological control of *Siphoninus phillyreae* (Homoptera: Aleyrodidae) on pomegranate in Egypt. Pan-Pacific Entomologist**,** 74(3):169-173.

Abd-Rabou, S. (1998c): A revision of the parasitoids of whiteflies from Egypt. Acta Phytopathologica et Entomologica Hungarica , 33(1-2):193–215.

Abd-Rabou, S. (2002): Revision of Aphelinidae (Hymenoptera) from Egypt. Second International Conference of Plant Protection Research Institute, Dokki, Giza, Egypt, 1:287.

Abd-Rabou, S. and Abou-Setta, M.M. (1998): Parasitism of *Siphoninus phillyreae* (Homoptera: Aleyrodidae) by aphelinid parasitoids at different locations in Egypt. Journal of Hymenoptera Research, 7(1):57-61

AFP (2020) : Egypt's blossoming trade in fragrant jasmine flowers.http://english.ahram.org.eg/NewsContent/1/64/378508/Egypt/Politics-/ Egypts-blossoming-trade-in-fragrant-jasmine-flower.aspx.

Chiun-Cheng, K.O. ; Chen, Y. and Dubey, A. K. (2010): New species of Dialeurodes Cockerell (Hemiptera: Aleyrodidae) with diagnoses and keys to puparia and adults from Taiwanens. Entomological Science , 13:121–133.

Cockerell, T. D. A. (1902): The classification of the Aleyrodidae. Proceedings of the Academy of Natural Sciences of Philadelphia, 54: 279-283.

Denmark, H. A. (1964): Florida Department of Agriculture's position on parasites and predators introduced into Florida for biological control.

Hyacinth Control Journal, 3: 16-19.

El-Borollosy, F.M.; Elbolok, M.M.; Ezz, A.I. and Assem, S.M. (1990): Ecological studies [in Egypt] on the Arabian jasmine whitefly *Dialeurodes kirkaldyi* Kotinsky (Aleyrodidae, Homoptera) on *Jasminum sambac* (Oleaceae). Bulletin de la Société Entomologique d'Égypte, 69:327-334.

Evans, G. (2007): The whiteflies (Hemiptera: Aleyrodidae) of the world and their host plants and natural enemies. USDA,Version 070606.

Evans, G.A. and Bennett, F.D. (1996): A new Eretmocerus (Hymenoptera:Aphilinidae) species reared from Dialeurodes kirkaldyi (Homoptera: Aleyrodidae). Florida Entomologist, 79 (4): 579-589 .

Guledagudda, S.S.; Hosaman, S.B.; Nalawadi, U.G.; Hiremath, G.K. and Basavaraj,H. (1997): An appraisal of financial feasibility of investment in jasmine.Karnataka J. Agric. Sci., 10(4): 1117-1122.

Helmi, A. (2005): Some ecological aspects of two whitefly species infesting arabian jasmine shrubs in Egypt (Hemiptera: Sternorrhyncha: Aleyrodidae). Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 13(3): 951 – 962.

Jesudasan, R.W.A. and David, B. V. (1991): Taxonomic studies of Indian Aleyrodidae (Insecta: Homoptera). Oriental Insects, 25: 231-434.

Kotinsky, J. (1907): Aleyrodidae of Hawaii and Fifi with descriptions of new species. Bulletin, Board of Commissioners of Agriculture and Forestry Hawaii, Division of Entomology, 2: 93-102.

Mariappan, V. and Ramanujam, K. (1975): Yellow ring mosaic of Jasminum spp. with particular reference to its transmission by an Aleurodid. South Indian Horticulture, 23 (1/2): 77-78.

Martin, J. H. and Mound, L. A. (2007): An annotated check list of the world's whiteflies (Insecta: Hemiptera: Aleyrodidae. Zootaxa, 1492: 1-84.

Martin, J. H.; Mifsud, D. and Rapisarda, C. (2000): The whiteflies (Hemiptera: Aleyrodidae) of Europe and the Mediterranean Basin. Bulletin of Entomological Research, 90: 407–448.

Mifsud , D. ; Cocquempot ,C.; Mühlethaler ,R. ; Wilson, M. and Streito, J. (2010): Other Hemiptera Sternorrhyncha (Aleyrodidae, Phylloxeroidea, and Psylloidea) and Hemiptera Auchenorrhyncha. Chapter 9.4. In: Roques A et al. (Eds) Alien terrestrial arthropods of Europe. BioRisk, 4(1): 511–552.

Mound, L. A. (1983): Biology and identity of whitefly vectors of plant pathogens. In: Plant virus epidemiology. The spread and control of insect-borne viruses. Blackwell Scientific Publications, Oxford, United Kingdom, 305-313.

Nguyen, R. and Hamon, A.B. (1989): *Dialeurodes kirkaldyi* (Kotinsky), in Florida (Homoptera: Aleyrodidae: Aleyrodinae). Entomology Circular (Gainesville). 323: 2.

Nguyen, R.; Sailer, R. I. and Hamon, A.B. (1993): Catalog of Aleyrodidae on citrus and their natural enemies (Homoptera: Aleyrodidae). Occasional papers

of the Florida State Collection of Arthropods, 8: pp 57 .

Pal, S. and Chakravarthy, A. K. (2020): Advances in Pest Management in Commercial Flowers. Apple Academic Press , New York,pp 304.

Polaszek, A.; Abd-Rabou, S. and Huang, J. (1999): The Egyptian species of Encarsia (Hymenoptera: Aphelinidae): a preliminary review. Zool. Med. Leiden, 73 (6): 131-163.

Priesner, H. and Hosny, M. (1940): Notes on parasites and predators of Coccidae and Aleurodidae in Egypt. Bulletin de la Société Fouad Ier d'Entomologie, Le Caire**,** 24:58-70.

Quaintance, A. L. and Baker, A. C. (1914): Classification of the Aleyrodidae Part II. Technical Series, Bureau of Entomology, United States Department of Agriculture, 27: 95-109.

Quaintance, A. L. and Baker, A. C. (1917): A contribution to our knowledge of the whiteflies of the sub-family Aleurodicinae (Aleyrodidae). Proceedings of the U. S. National Museum, 51: 335-445.

Rabeena, A. ; Bose, S.C. and Sathyan, T. (2020): Pests of jasmine and their management. Research Today, 2(6): 414-415.

Russell, L. M. (1964): *Dialeurodes kirkaldyi* (Kotinsky), a whitefly new to the United States (Homoptera: Aleyrodidae). Florida Entomologist, 47 (1): 1-4.

SAS Institute (1998): SAS user's guide. Statistics SAS Institute, cary, N.C.

Sundararaj, R. and David, B.V. (1992): Host correlated variation in *Dialeurodes kirkaldyi* (Kotinsky) (Aleyrodidae: Homoptera). Hexapoda, 4 (1): 33 - 38.

Sundararaj, R. and Dubey, A. K. (2006): A review of the whitefly genus *Dialeurodes* Cockerell (Aleyrodidae: Hemiptera) with descriptions of two new species from India. Journal of the Bombay Natural History Society, 103(1): 62-67.