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Seasonal incidence of citrus blackfly, citrus whitefly and their natural enemy during Mrig bahar

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Abstract
A field experiment was conducted to study the Seasonal incidence of citrus blackfly, citrus whitefly and their natural enemy during Mrig bahar 2020. The study revealed that the populations of Citrus blackfly, whitefly, ladybird beetle and *Chrysoperla carnea* varied from 15.6 to 26.2 blackfly/ twig, 0.2 to 3 whiteflies/ twig, 0.0 to 1.6 LBB/ twig and 0.0 to 1.2 *Chrysopa*/ twig respectively. The peak incidence of blackfly (26.2 blackfly/ twig) observed on 41th SMW and 44th SMW, whitefly (3 whitefly/twig) observed on 48th SMW and their natural enemies ladybird beetle (1.6 LBB/ twig) observed on 44th SMW and *Chrysoperla carnea* (1.2 *Chrysopa*/ twig) were observed on 44th SMW and 47th SMW. The correlation study revealed that maximum temperature positively correlated with blackfly, whitefly and both predators, while minimum temperature positively correlated with predators but, negatively correlated with both pests. Morning relative humidity and evening relative humidity negatively correlated with both pests and predators, while rainfall positively correlated with predators and negatively correlated with both fly.

Keywords: Seasonal incidence, blackfly, whitefly, sucking pests, citrus, Mrig bahar

1. Introduction
Sweet orange (*Citrus sinesis* L. Osbeck) is the second most popular and lucrative crop in the Citrus group and it is cultivated all over the world. It is grown mainly in Brazil, China, Japan, Turkey and India. In India, the primary Sweet Orange growing states are Andhra Pradesh, Maharashtra, Karnataka, Punjab, Rajasthan and Haryana. In India, the area under Sweet Orange cultivation is 184.6 thousand ha with a production of 3265.8 thousand MT and a productivity of 6.1 MT/ha. (Anonymous, 2018) [1].

Citrus psylla, blackfly, whitefly, leaf miner and fruit sucking moth are some of the most significant. Citrus blackfly and whitefly are the most common sucking pests of citrus in India and other citrus-growing countries, and they have been observed throughout the year (Pruti and Batra 1960) [13]. Citrus blackfly can reduce citrus productivity by up to 80% by interfering with fruit production and exports. 5 to 10 nymphs per square centimeter are sufficient to lower nitrogen levels below the 2.2 % required for orange fruit growth (Bhut and Jethva, 2017) [3]. Citrus whitefly caused about 45 to 50% loss of citrus crop in Florida. Both pests causes the most damage by sucking cell sap from the phloem, depleting nutrients and perhaps disabling the plant by injecting toxic saliva (Silva *et al*., 2011) [15]. It excretes sugary honeydew, which coats the leaf and fruit surface and promotes the growth of saprophytic fungus such as sooty mould (*Capnodium citri* Berk and Desm) (Oliveira *et al*., 1999) [8].

Now a day, sucking pests are causing severe menace in citrus cultivation hence, it is necessary to examine the comprehensive information regarding the pest complex and the importance of pests in respect to changing scenario of climatic factors working on behavior and ecology of sucking pests helps in finding out the weak links of a pest population that could be exploited to curb their infestation and disease transmission by devising the suitable strategies for pest management. Thus the present investigation was carried out to study the seasonal incidence of Citrus blackfly and whitefly in relationship with weather parameters.

2. Material and Methods
The field trial was carried out to study the seasonal incidence of major sucking pests of citrus (Citrus blackfly and whitefly) and their predators during Mrig bahar 2020 in relation to weather parameters on the sweet orange orchard of Nimkheda village under the guidance of Research Guide, Department of Agricultural Entomology, College of Agriculture, Badnapur.

The six year old untreated plant of Nucellar variety of sweet orange was selected for the field trial. A single plant was selected for experiment. The seasonal incidence of Citrus blackfly, whitefly (nymph & adult count) and population of their predators (grubs & adults) were recorded from five randomly selected tender terminal twigs of 15cm length. The citrus plant was selected for observation was kept untreated throughout the season. The observations recorded at weekly interval till harvest and data generated was correlated with weather parameter (Wagh, 2016) [16].

3. Results and Discussion

The observation recorded on seasonal incidence of major sucking pests of citrus are presented below.

3.1 Seasonal incidence of Citrus blackfly (*Aleurocanthus woglumi* Ashby)

The data recorded on seasonal incidence of blackfly affecting the citrus crop during Mrig bahar 2020 presented in Table 1 revealed that the population of blackflies was observed from 31st SMW to 52nd SMW of 2020, showed that the occurrence of blackfly observed in a whole season. Blackfly population on citrus was ranged from 15.6-26.2 blackfly/twig. The peak population of blackfly 26.2 blackfly/twig was noticed in 41st and 44th SMW. Thereafter the population went on decreasing. The present findings are conformity with earlier workers Parekh *et al*. (2016) [9] reported that higher population of citrus blackfly, *A. woglumi* was observed on citrus during April to 4th week of September. Kumar *et al.* (2021) [5] who reported that *A. woglumi* was found to occur more in August and October month and lesser in November.

3.2 Seasonal incidence of Citrus whitefly (*Dialeurodes citri* Ashmead)

The data regarding population of whitefly presented in Table 1 showed that whitefly population ranged from 0.2-3 whiteflies/twig on citrus observed from 31 SMW to 52 SMW 2020. The incidence of whitefly started from first week of august (31st SMW) and reached 3 whiteflies/ twig at the end of November (48th SMW). The peak incidence of whitefly was noticed in 48th SMW which was 3 whiteflies/ twig. The result are in line with the finding of earlier workers Saini *et al.* (2016) [14] who reported *r*esults of weekly observations on the pest population of Nymph and adult of *D. citri* was available on the crop from 12th to 47th meteorological standard weeks (SW). Lekurwale and Kadam (2017) [7] who reported that population of citrus whitefly, *Dialeurodes citri* was high from first week of January to second week of March and third week of October to last week of December (42nd to 52nd MW).

3.3 Seasonal Incidence of natural enemies

3.3.1 Ladybird beetle (Coccinellid)

The population of ladybird beetles showed in Table 1 was noticed during 31st SMW to 52nd SMW (August to December) and it was ranged between 0.0 to 1.6 LBB/ twig. The population of ladybird increased from last week of August (35th SMW) to the first week of November (44th SMW) with the range of 0.6 to 1.6 LBB/ twig and thereafter it gradually decreases. The highest population of ladybird beetle (1.6 LBB/ twig) was observed in 44th SMW. The present study supported by the findings of Chavan *et al*. (2018) [4] reported that highest population of natural enemies was noticed from first week of September to first week of November *i.e.* 35th to 44th MW.

Table 1: Seasonal incidence of major sucking pests of citrus and their natural enemy in relation to weather parameter.

SMW	Sucking pests/ twig		Natural enemies/ twig		Weather parameters				
	Blackfly	Whitefly	LBB	*Chrysopids*	Temperature (^{0}C)		Rainfall (mm)	R.H (%)	
					Max.	Min.		Morn.	Even.
31	15.6	0.6	0.8	01	31.8	21.3	94.6	89.7	76.8
32	16.8	0.2	0.6	0.6	30.9	20.9	36.0	89.6	72.5
33	15.8	0.4	00	00	26.1	19.9	82.0	94.3	90
34	16.6	0.6	00	0.4	28.6	20.1	31.0	92.1	72.9
35	18.6	1.2	0.6	0.6	30.1	20.2	36.0	89.7	73.4
36	19.2	1.4	01	01	33.1	21.1	49.5	85.7	63
37	21.6	1.8	0.6	0.2	31.6	20.9	15.7	89.9	72
38	25.8	1.6	0.8	01	30.9	21.5	92.0	88	78.1
39	24.8	1.4	1.4	01	29.8	19.6	122	89.7	72.1
40	25	2.4	01	01	33.0	20.0	00	81.4	54.7
41	26.2	1.8	0.8	0.8	31.4	20.1	47.5	87.4	64.1
42	22.4	02	1.4	01	31.4	20.9	44.0	82.7	58.1
43	20.8	1.8	0.6	0.4	31.1	18.2	30.7	92.7	67.8
44	26.2	2.4	1.6	1.2	33.4	15.3	00	75.1	36
45	26	1.8	1.2	01	33.2	12.7	00	75	33.7
46	20.6	2.8	1.4	0.8	31.3	15.6	00	71	49.1
47	22.4	2.8	0.6	1.2	32.6	16.7	00	68.1	48.4
48	22.6	03	0.8	0.4	30.1	15.7	00	67.6	36.1
49	24.8	2.2	0.6	0.6	31.5	13.9	00	67.1	40.1
50	22.6	1.8	0.4	0.8	30.0	16.1	00	68.3	45.4
51	21.8	0.6	0.0	0.0	29.6	11.8	00	65.0	42.4
52	25.8	1.6	0.2	0.2	30.1	13.4	00	70.3	44.0

3.3.2 *Chrysopa*

The data pertaining to *Chrysopa* population was first recorded on the plants of Citrus in the 31st standard week and continued till 50th standard week in the range of 0 to 1.2 *Chrysopa*/twig. The maximum population (1.2 *Chrysopa*/ twig) was observed during last week of October (44th MW) and 3rd week of November (47th MW). The present results were in accordance with those of Patel and Radadia (2018) [10] studied that *Chrysoperla* observed initially from 36th SMW (0.04 *Chrysopa*/ plant) and remained up to 51st SMW with peak

population in 40th SMW (0.36 *Chrysopa*/ plant).

3.4 Correlation coefficient between sucking pests of Citrus with weather parameters.

3.4.1 Blackfly (*Aleurocanthus woglumi)*

Data incorporated in Table 2 showed that the blackfly population was negative significant correlation with minimum temperature, morning relative humidity and evening relative humidity *i.e.* (r = - 0.43), (r = - 0.46) and (r = - 0.59) respectively and rainfall impact was negative (r = - 0.28) but it was non-significant whereas maximum temperature (r = 0.44) showed significant positive correlation with blackfly population. These findings were agreed with Poovizhiraja *et al*. (2019) [11] who reported that maximum temperature show significant positive interaction (r = 0.70), relative humidity had significant negative interaction (r = - 0.22), whereas rainfall exhibited non-significant relationship (r = 0.17). Lekurwale (2014) [6] who studied that minimum temperature and evening RH showed negative significant (r = - 0.72 and r = - 0.28) correlation with blackfly while rainfall exhibit negative significant impact (r = - 0.38).

3.4.2 Whitefly (*Dialeurodes citri)*

According to the data presented in Table 2 whitefly population had non-significant, negative correlation with minimum temperature (r = - 0.32) and significant negative correlation with morning R.H. (r = - 0.55), evening R.H. (r = - 0.62) and rainfall (r = -0.50). While the impact of maximum temperature on blackfly was positively significant (r = 0.51). The present finding was more or less in conformity with Lekurwale (2014) [6] who reported that correlation study between *Dialeurodes citri* and weather factor revealed that rainfall (r = -0.42), Minimum temperature (r = -0.71) and evening RH (r = -0.35) negatively significant. According to Priyadarshini *et al.* (2018) [12] whitefly showed negative significant correlation with minimum temperatures (r = -0.29) and both maximum (r = - 0.09) and minimum (r = -0.21) relative humidity showed non-significant negative impact while rainfall exhibit negative significant correlation (r = - 0.32) with whitefly.

Table 2: Correlation between sucking pest of Citrus with weather parameters

Name of pests	Correlation coefficients (r)				
	Temperature (ºC)		Relative humidity		Rainfall
	Maximum	Minimum	Morning	Evening	
Blackfly	0.444*	-0.438*	-0.469*	-0.595**	-0.288NS
Whitefly	0.518*	-0.325NS	-0.553**	-0.627**	-0.506*

** Significant at 1% and * Significant at 5%.

3.5 Correlation coefficient between natural enemies of Citrus with weather parameters

3.5.1 Lady bird beetle

The data related to correlation coefficients between weather parameters and ladybird beetle population presented in Table 3 indicate that the correlation between ladybird beetle population on Citrus and Morning RH (r = -0.034) and evening RH (r = -0.248) were found negatively non-significant, whereas maximum temperature (r = 0.655) showed positively significant correlation and minimum temperature (r = 0.088) and rainfall (r = 0.089) were showed positive non-significant correlation. The present study supported by findings of Aruna *et al*. (2017) [2] who noticed that *Coccinellids* were negatively significant correlated with morning RH (r = - 0.42) and evening relative humidity (r = - 0.43) while with maximum and minimum temperature was positively significant (r = 0.85 & r = 0.64) with rainfall the population of *Coccinellids* positively non-significant (r = 0.41).

3.5.2 *Chrysopids*

The data (Table 3) indicated that minimum temperature (r = 0.196) and rainfall (r = 0.138) showed positive non-significant correlation with *Chrysopa* while Morning RH (r = -0.048) and evening RH (r = -0.167) exhibited non-significant negative correlation. Whereas maximum temperature (r = 0.709) were found positively significant with *Chrysopa* population in Citrus. The finding Aruna *et al*. (2017) [2] who noticed that the *Chrysopa* was negatively significant correlated with morning RH (r = -0.50) and evening relative humidity (r = - 0.51) while with maximum and minimum temperature was positively significant (r = 0.82 & r = 0.57) and with rainfall the population of *Chrysopa* positively non-significant (r = 0.35) support the present investigation.

Table 3: Correlation coefficient between natural enemies of Citrus with weather parameters

Name of Pests	Correlation coefficients (r)				
	Temperature		Relative humidity		Rainfall
	Maximum	Minimum	Morn.	Eve.	
LBB	0.655**	0.088NS	-0.034NS	-0.248NS	0.089NS
Chrysopids	0.709**	0.196NS	-0.048NS	-0.167NS	0.138NS

** Significant at 1% and * Significant at 5%.

4. Conclusion

The peak period of Blackfly noticed in first fortnight of August to end of October, Whitefly noticed in first week of August to end of November and predator noticed in last week of August to first week of November during Mrig bahar. Infestation of these insects increased with increased temperature. Infestation of these insects decreased with increased humidity.

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