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Population dynamics of leaf miner, *Phyllocnistis citrella* (Stainton) infesting sweet orange

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Abstract
Investigations on population dynamics of leaf miner, *Phyllocnistis citrella* infesting sweet orange were carried out under field condition during 2016-17 at Horticultural Research Station, Junagadh Agricultural University, Junagadh. The infestation of *P. citrella* (14.90%) started from 1st week of December, 2016 (48th SMW) and showed first peak (19.80%) during 5th week of December (52nd SMW). The infestation again increased and reached to its second peak (22.50%) during 3rd week of September (37th SMW). There was negative highly significant impact on the incidence of leaf miner due to MaxT [-0.501**] and wind speed [-0.559**] but there was no any significant linear correlation either negative or positive between incidences of leaf miner population for rest of the physical factors. However, MinT [-0.202] were negatively and relative humidity (RH_1 [0.173], RH_2 [0.195]) were positively whereas bright sun shine hours (BSS) [-0.100] were negatively correlated with the incidence of leaf miner population but the relationship was non-significant.

Keywords: Citrus leaf miner, *Phyllocnistis citrella*, population dynamics, sweet orange

1. Introduction
The word "citrus" is derived from the ancient Greek *Kedros* and Latin *Cedrus*. The sweet orange, *Citrus sinensis* is the fruit of the citrus in the family Rutaceae. The fruit of the orange tree can be eaten fresh or processed for its juice or fragrant peel. Among the different citrus trees, sweet orange occupies number one position in production in the world by accounting for about 70 per cent of the total production [1]. Among the different citrus fruits, pulp of orange is an excellent source of vitamin C and provides 64 per cent/100 g serving of daily value. In India, so many factors *viz.*, biotic and abiotic are limiting the production of sweet orange per unit area. Among several biotic factors insect pests and diseases caused enormous damage to the particular crop. In India, leaf miner, *Phyllocnists citrella* (Stainton) (Phyllocnistidae: Lepidoptera) is a major insect pest inflicting severe damage in citrus (Kagzi lime) orchard and now becoming a major pest of citrus as well as sweet orange in Gujarat [3]. In the situation of global climate change, living organisms are changing their living habitat as well as style which directly affect their span of life. A dominant animal, insect, have capacity to change their behavior and habitat with the changing of the environment and so, it was necessary to see the impact of changing pattern in abiotic factors on sweet orange leaf miner.

2. Materials and Methods
In order to determine the population dynamics of citrus leaf miner, experiment was carried out on sweet orange at Horticulture Instructional farm, College of Agriculture, JAU, Junagadh during December, 2016 to November, 2017.The population dynamics of *P. citrella* on citrus was carried out from ten unsprayed trees of citrus (10 years old) from one location. Total 100 leaves per tree (25 leaves from each side of tree) were observed at weekly interval. Number of healthy and damaged leaves was counted on the basis of typical damage caused by citrus leaf miner i.e. serpentine galleries, twisted and folded leaves were considered as a damaged leaves. Per cent infestation was worked out by using following formula.

$$\text{Infestation (\%)} = \frac{\text{Number of infested leaves}}{\text{Total number of observed leaves}} \text{ X } 100$$

The weekly meteorological data on different abiotic parameters were obtained from the meteorological observatory of Junagadh Agricultural University, Junagadh.

Simple correlations between periodical mean values of leaf miner (*Phyllocnistis citrella*) with various abiotic parameters were computed.

3. Results and Discussion

3.1 Infestation due to citrus leaf miner, *Phyllocnistis citrella*

The data (Column 4 & 8 in Table 1) indicated that the infestation of leaf miner commenced from 1st week of December, 2016 *i.e.* 48th Standard Meteorological Week (SMW) and continued till 4th week of November, 2017 (47th SMW) which was ranged from (8.70%) to (22.25%) infestation by *P. citrella*. The damage of *Phyllocnistis citrella* was observed throughout the year on the citrus and it was also fluctuated. The infestation (14.90%) was started from 1st week of December, 2016 (48th SMW) and showed first peak (19.80%) during 5th week of December (52nd SMW). During the subsequent weeks, incidence was decreased and reached to minimum (8.70%) during 4th week of May (21st SMW). Thereafter, the infestation was again increased and reached to its second peak (22.50%) during 3rd week of September (37th SMW). In all, infestation of *P. citrella* was found throughout the year with two peaks.

In all, it was found that relatively higher (22.50%) to (21.40%) infestation of leaf miner was observed during 3rd week of September to 5th week of September having highest peak on 3rd week of September. Highest and lowest population of *P. citrella* was found during the week of September and the first week of January, respectively on *Kagzi* lime [6]. While, in Akola, leaf miner was recorded from April and attained its peak during fortnight of September (14.40%), second fortnight of October (18.76), first fortnight of November (15.81%) and second fortnight of January (13.91%) [4]. Leaf miner recorded peak in September [2]. Overall, the results of the present investigation follow more or less similar trend with earlier reports.

3.2 Effect of weather parameters on leaf miner, *Phyllocnistis citrella* population

The data (Column 2 in Table 2) on association between leaf miner infestation and weather factors indicted that there was negative highly significant impact on the incidence of leaf miner due to MaxT [-0.501**] and wind speed [-0.559**]. There was no any significant linear correlation either negative or positive between incidences of leaf miner population for rest of the physical factors. However, MinT [-0.202] were negatively and relative humidity (RH_1 [0.173], RH_2 [0.195]) were positively whereas bright sun shine hours (BSS) [-0.100] were negatively correlated with the incidence of leaf miner population but the relationship was non-significant. Maximum temperature, maximum relative humidity, maximum vapour pressure and were found as most influencing factors and showed positive effect on the activity of *P. citrella* and leaf infestation whereas, minimum relative humidity, minimum vapour and evaporation had a direct negative effect [5].

Table 1: Incidence of leaf miner, *Phyllocnistis citrella* (Stainton) in sweet orange

Sr. No.	SMW	Month	% infestation *P. citrella*	Sr. No.	SMW	Month	% infestation *P. citrella*
1	2	3	4	5	6	7	8
1	48	December 2016	14.90	27	22	June	10.50
2	49		14.10	28	23		10.60
3	50		18.30	29	24		10.70
4	51		19.00	30	25		10.40
5	52		19.80	31	26		10.50
6	1	January 2017	16.40	32	27	July	12.00
7	2		16.60	33	28		12.20
8	3		16.00	34	29		12.90
9	4		15.30	35	30		11.60
10	5	February	13.00	36	31	August	12.80
11	6		13.50	37	32		13.40
12	7		13.30	38	33		13.70
13	8		12.50	39	34		14.50
14	9	March	12.40	40	35	September	17.00
15	10		12.50	41	36		19.50
16	11		11.40	42	37		22.50
17	12		11.20	43	38		21.50
18	13		10.90	44	39		21.40
19	14	April	9.70	45	40	October	19.30
20	15		9.20	46	41		19.00
21	16		9.80	47	42		20.30
22	17		8.90	48	43		13.60
23	18	May	9.10	49	44	November 2017	13.50
24	19		8.90	50	45		13.40
25	20		9.30	51	46		12.00
26	21		8.70	52	47		12.10

Table 2: Correlation of *Phyllocnistis citrella* with abiotic factors in sweet orange

Factors	Incidence of leaf miner ('r' value)
1	2
Bright Sunshine Hours, hrday^{-1} (BSS)	-0.100
Maximum Temperature, ^{0}C (MaxT)	-0.501**
Minimum Temperature, ^{0}C (MinT)	-0.202
Morning Relative Humidity, % (RH_1)	0.173
Evening Relative Humidity, % (RH_2)	0.195
Wind Speed, kmhr^{-1} (WS)	-0.559**

* Significant at 5% level (r = 0.273)
** Significant at 1% level (r = 0.354)

4. Conclusion

In all, infestation of *P. citrella* was found throughout the year with two peaks. It was also found that relatively higher (22.50 to 21.40%) infestation of leaf miner was observed during 3rd week of September to 5th week of September having highest peak on 3rd week of September.

Association between leaf miner infestation and weather factors indicted that there was negative highly significant impact on the incidence of leaf miner due to MaxT [-0.501**] and wind speed [-0.559**]. There was no any significant linear correlation either negative or positive between incidences of leaf miner population for rest of the physical factors. However, MinT [-0.202] were negatively and relative humidity (RH_1 [0.173], RH_2 [0.195]) were positively whereas bright sunshine hours (BSS) [-0.100] were negatively correlated with the incidence of leaf miner population but the relationship was non-significant.

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