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Influence of Weather Parameters on Seasonal Incidence of Citrus Leaf Miner (*Phyllocnistis citrella* Stainton) in Sweet Orange cv. Sathgudi

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ABSTRACT

Seasonal activity of the citrus leaf miner, *Phyllocnistis citrella* Stainton was investigated during 2009 and2010 in Sweet Orange at Citrus Research Station, Tirupati, Andhra Pradesh. The leaf miner activity was noticed throughout the year with peak infestation during winter (September to January) months and low or nil damage in peak summer (April, May) months. Peak infestation of *P.citrella* was recorded as 38.4% and 35.4% during the months of December and October in 2009 and 2010 respectively. During the entire study period leaf damage caused by *P.citrella* ranged between 0.3 to 38.4%. Correlation studies of the pest incidence with meteorological data from 2001-2010 indicated that pest damage was positively correlated with both morning (RH1) and evening (RH2) relative humidity (r = 0.561207 and 0.436502) and negatively correlated with minimum temperature (r = -0.62829) and wind velocity (r = -0.51968). Regression analysis resulted that about 79% contribution of observed variation in pest infestation is due to the biotic (existing pest activity on available new flush) and abiotic factors (Temperature, Relative humidity and wind velocity) together.

Key words : Citrus leaf miner, Meteorological data, Seasonal abundance.

The citrus leaf miner, *Phyllocnistis citrella* Stainton, was originated from South East Asia and established itself as a major pest of citrus throughout, most of the Asian countries including India. The pest attacks all the cultivars of citrus, related species within the Rutaceae family (Legaspi and French, 1996). Leaf miner causes both direct (Reduction on Photosynthetic area) and indirect damage (facilitating citrus canker bacteria invasion). Bruce *et al*., 1997, reported that there exists a negative correlation between net photosynthesis rate of trees and leaf damage by the leaf miner. Plant damage is caused by the leaf miner larvae as they bore through the leaf epidermis, leaves become chlorotic, often deformed and susceptible to infection by fungi and bacteria. Leaf miner larvae were generally found mining underside of the newly formed leaves of fresh growth. The adults prefer to lay eggs on 1-1.5 cm length new leaves. A single larva can consume about 1-7 cm^2 leaf area and leave 6-11.5 inch mines (David Kerns *et al*., 2002). Many factors influence annual leafminer population density, including weather and grove management practices. The abundance of citrus leafminer is closely tied to the availability of young, flushing foliage needed for development of the larval stage. Till now only method of pest control available is chemical control. But recently it was reported over 60% parasitism (predators and parasites) during the month of December (David Kerns *et al*., 2002). Thus biological control provides a good alternative to the chemical control. In order to promote bio control agents there is a need to monitor the pest activity regularly and also to study the relationship of the pest with other biotic and abiotic factors. Lack of sufficient information about the population dynamics of the pest and other related factors motivated to take up the present study on seasonal incidence of the pest and to develop some forecasting models based on the weather parameters.

MATERIAL AND METHODS

Studies on seasonal activity of the pest were conducted from January to December during 2009 and 2010 at fortnightly intervals in a fixed plot (0.5 ha) at Citrus Research Station, Tirupati, Andhra Pradesh. The data on per cent infested leaves were recorded on 30cm fresh twigs at three directions (North, South and East) on fifteen selected plants in the fixed plot at 15 days interval throughout the year. During the experimental period

Table 1 Citrus leaf miner incidence and weather parameters recorded during 2009 and 2010.

Year	Month	Leaf miner damage (%)	Tmax	Tmin	RH1	RH2	WV	SSHR	RF
2009	I FN Jan	24.5	28.6	17.1	81.8	52.2	7.29	7.95	2
	II FN Jan	14.2	30.75	16.2	81.3	44.2	5.64	9.01	0
	I FN Feb	16.7	32.76	16.5	79.3	37.4	4.79	9.2	0
	II FN Feb	25.4	34.46	18.1	77.4	35	5.63	9.4	0
	I FN Mar	16.6	36.07	22.3	77.6	34.6	5.7	8.5	0
	II FN Mar	12.5	36.4	23.2	74.2	32.1	6.6	7.8	0
	I FN Apr	8.5	37.9	23.2	74.2	32.1	6.6	7.8	0
	II FN Apr	4	39.5	26.3	70	33.4	6	6.7	1
	I FN May	0	41	27.2	64.2	29	6.59	6.12	26.8
	II FN May	0	38.1	26.9	60.1	36.5	8.93	3.66	27.1
	I FN June	6.5	37.8	26.9	60.1	36.5	8.9	3.6	28.6
	II FN June	8.9	37.4	27.2	56.5	34.7	13.3	6.1	19.6
	I FN July	9.5	35.7	26.5	63.1	40.2	12.3	2.2	17.2
	II FN July	11.4	37.1	26.9	60.3	35.3	13.1	3.1	10
	I FN Aug	12.4	35.6	26.5	64.6	42.3	9.8	4.9	100.8
	II FN Aug	13.6	32.7	24.3	76.6	52.9	7.1	3.5	70.3
	I FN Sept	14.8	35	25.4	68.5	44	8.3	5.3	7.4
	II F N Sept	20.5	33.7	25	71.8	50.4	7.1	5.3	45.9
	I FN Oct	24.8	33.8	25	71.8	50.4	7.1	5.3	10.1
	II FN Oct	29.6	32.1	22	75	49.5	6.9	5.7	54.7
	I FN Nov	35.4	28.6	23.1	87.9	72.6	5.5	1.9	133.2
	II FN Nov	36.2	28.6	23.1	87.9	72.6	5.5	1.9	15
	I FN Dec	38.4	28.8	20.3	79.9	59	6.8	4.1	47.4
	II FN Dec	35.2	27.9	17.8	80.4	59.5	6.5	3.8	11.1
2010	I FN Jan	32.5	29.03	16.81	88.93	61.60	5.29	6.57	0.00
	II FN Jan	24.2	30.33	15.34	89.19	49.06	4.73	8.21	0.00
	I FN Feb	16.7	31.23	13.93	88.40	34.60	5.7	8.49	0.00
	II FN Feb	12.40	32.42	20.71	89.15	43.31	5.67	6.78	0.00
	I FN Mar	9.23	34.82	16.80	74.73	29.13	6.35	9.25	0.00
	II FN Mar	5.40	33.50	17.80	85.00	36.50	6.26	9.15	0.00
	I FN Apr	0.30	39.87	26.21	67.13	29.20	6	7.50	0
	II FN Apr	0.27	39.71	27.13	67.20	31.80	6	7.85	0
	I FN May	0.00	39.85	26.77	68.80	31.80	6.74	7.81	55.80
	II FN May	0.00	39.62	28.84	60.56	36.81	11	5.99	53.00
	I FN June	4.50	35.01	26.61	65.33	45.87	10.2	3.36	22.80
	II FN June	12.80	35.98	25.69	74.33	45.60	7.68	4.85	97.40
	I FN July	10.50	33.29	21.42	78.70	46.23	6.95	6.62	88.70
	II FN July	14.60	33.45	21.68	78.43	46.19	6.87	6.64	78.30
	I FN Aug	11.40	34.09	21.48	77.18	42.67	6.46	6.80	27.90
	II FN Aug	6.70	34.05	21.49	77.26	42.89	4.58	6.78	117.80
	I FN Sept	13.20	34.81	21.81	76.87	40.69	6.09	7.06	77.50
	II FN Sept	28.50	35.15	22.13	76.09	39.44	4.13	7.07	53.10
	I FN Oct	35.40	35.13	22.11	76.14	39.52	3.81	7.07	7.10
	II FN Oct	30.20	35.71	23.10	74.45	39.21	4.11	6.90	96.40
	I FN Nov	33.50	35.89	23.20	73.59	38.96	3.59	6.92	100.90
	II FN Nov	29.40	35.95	23.62	73.57	39.63	4.27	6.76	72.80
	I FN Dec	33.49	35.94	23.59	73.57	39.59	4.67	6.77	24.40
	II FN Dec	27.90	36.10	23.95	72.85	39.78	4.96	6.62	14.00

Note: Tmax-Maximum temperature (Degrees), Tmin- Minimum temperature (Degrees), RH1-Morning Relative Humidity (Per cent), RH2-EveningRelative Humidity (Per cent), WV-Wind velocity (Km/hour), SSHR-Daily Sunshine hours, RF-rain fall (mm).

Seasonal incidence of leaf miner during 2009&2010

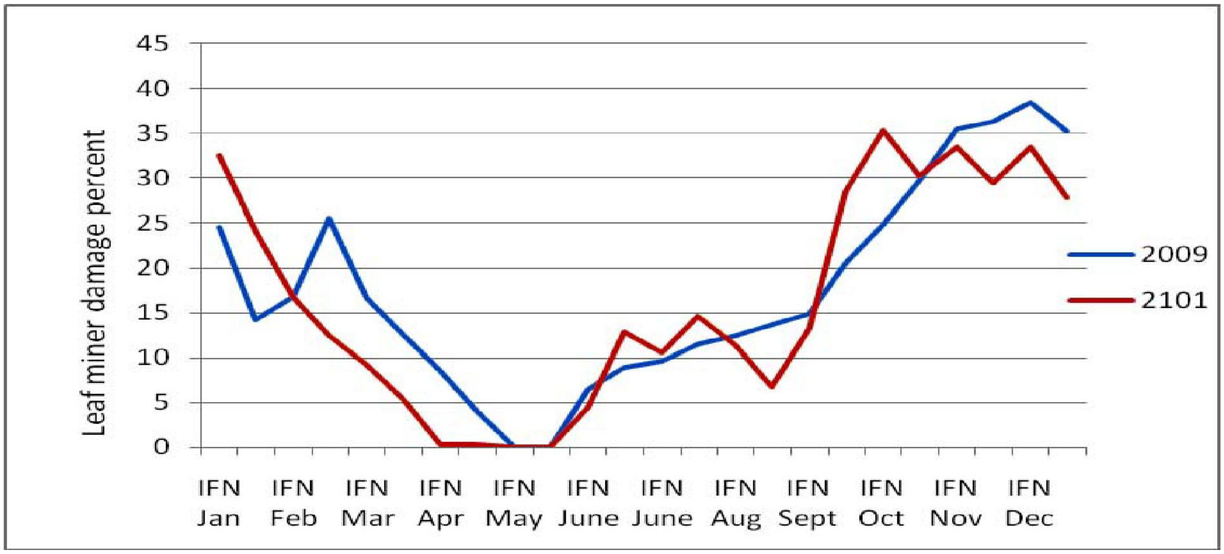

Table 2. Correlation coefficient (r) between leaf miner infestation and meteorological factors in Sweet Orange.

	Tmax	Tmin	RH1	RH2	Wind	Sunshine	Rainfall
Percent pest infesta-tion	-0.08203	-0.062829*	0.561207*	0.436502*	-0.51968*	-0.01632	0.034959

Significant value of correlation *r = 0.3211 (p = 0.001).

pest control measures were not taken up with any of the pesticides. The historical pest data from 2001 to 2010 were correlated with weather parameters. Meteorological data was obtained from the Regional Agricultural Research Station, Tirupati, which is located at half a kilometre distance from the experimental station. Regression analysis was carried out on percentage pest infestation (dependant variable) and weather parameters (Temperature, Relative humidity, Wind velocity, Sunshine hours and Rainfall) and forecasting models were developed.

RESULTS AND DISCUSSION

The results from the Table1 indicated that there was an increasing trend in the pest activity from June to January during both the years. This may be due to intermittent rains which supported new flush growth followed by congenial weather conditions which must have supported larval growth. Later on as the summer proceeds there was a decreasing trend in pest activity. Peak infestation of *P. citrella* was recorded in (September to January) winter months during both the years. Highest pest infestation was recorded as 38.4% and 35.4% during the months of December and October in 2009 and 2010 respectively. During this period average temperatures and relative humidity ranged between 22.5-28.5^{0}C and 61-80% respectively. These findings are on par with Qamar *et al.*, (2011), who reported heavy leaf miner infestation during September and October Months in Pakistan and Jesusa *et al*., (2011), reported peak pest population during mid October and July in Texas. Leaf damage due to *P. citrella* ranged between 0.3 to 38.4% at Citrus Research station, Tirupati, but Lara *et al*., (1998) reported 12-85% leaf damage and Qamar *et al*., (2011), reported 2-55% leaf damage. Low or nil damage was recorded during the months April and May. This may be attributed to high temperatures (>38^{0}C) and non-availability of the new flush during these months. In the same way Qamar *et al*., (2011) also reported low pest damage in April and May months.

Correlation analysis between percent pest damage and various weather parameters indicated a positive correlation with both morning (RH1) and evening (RH2) relative humidity (r = 0.561207 and

0.436502) and significant negative correlation with minimum temperature (r = -0.62829) and wind velocity (r = -0.51968). Similar association of this pest with abiotic factors were reported by Greve *et al*., (2006). Regression models were developed using significantly correlated weather factors with pest infestation.

$Y= 39.358 -1.41\ Tmin +0.005\ RH1 +0.257\ RH2 - 0.776\ WV\ (R^2 = 0.5022)$

Where, Y = Predicted pest damage per cent

The regression analysis results indicated that meteorological parameters like minimum temperature, relative humidity and wind velocity together explain about 50% observed variation in pest infestation. But Patricia A. Diez *et al*., (2006) reported that temperature and rain were positively correlated to increase in pest population in Argentina. Again to increase the efficacy of the above model some biotic factors like previous fortnight's pest infestation data were also included as one of the independent factors and one more prediction model was developed as follows.

Y= 26.42 - 0.80Tmin -0.004 RHI - 0.075 RH2 - 0.11 WV + 0.72 previous fortnight's leaf miner damage per cent ($R^2 = 0.7958$)

The above model indicates that pest infestation was influenced by minimum temperature, relative humidity and wind velocity to the extent of 79%. With the help of the above prediction models the per cent pest infestation could be predicted at least 15 days in advance so as to forewarn the farmers about the pest management activities. These results showed that climatic factors have direct influence on pest activity. In addition availability of the resources (new flush) is also one of the major contributing factors in predicting the pest activity. Hence further studies needs to be taken up on this line of pest behaviour.

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