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Seasonal incidence and influence of weather factors on population dynamics of leaf webworm, *Nausinoe geometralis* Guenee in Jasmine (*Jasminum sambac* L.) ecosystem

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Abstract

A study was conducted to assess the population dynamics of jasmine leaf webworm in jasmine ecosystem in two different climate zone *ie* Madurai and Coimbatore District of Tamil Nadu. It was evident from the study that the occurrence of jasmine leaf webworm, *Nausinoe geometralis* was less severe during December and January and the leaf web worm density varied from 14.62 and 19.65 percent in Madurai District, while the incidence was minimum from December till February in Coimbatore district with the population varying from 12.75-19.42 percent. The leaf webworm population was found to increase steadily in summer months in both the districts, slightly declined in the month of June due to showers of rainfall and then the incidence rebound. The peak incidence was noticed in the months of September, October and November in both the investigated districts. From the present investigation it is evident that the jasmine leaf webworm population in jasmine had a significant positive correlation with maximum temperature, (r = +0.395) and (r=+0.304) and negatively for relative humidity (r=-294) and (r=-0.338) and rainfall (r= -0.368) and (r=-0.334) in Madurai and Coimbatore districts respectively. A significant positive correlation was recorded for sunshine hours and wind velocity on both the investigated districts.

Keywords: Population dynamics, leaf webworm, *Nausione geometralis, Jasminum sambac,* Madurai, Coimbatore, correlation

Introduction

Jasmine (*Jasminum sambac* L.) known in persian as yasmin *ie*. 'Gift of God' is one of the oldest fragrant flowers of India. It is traditionally as well as commercially cultivated for its sweet-scented flowers. In India, jasmine occupies an area of about 8,000 ha with an annual production of flowers worth Rs. 80-100 million. Tamil Nadu is the leading producer of jasmine in the country with an annual production of 77, 247 tonnes in an area of 9,360 [1]. Flowers and un opened buds are used for making garlands, bouquets, in religious and ceremonial functions, perfumed hair oils, attars, soaps, wine and drinks [2]. It is used for production of jasmine concrete, which is the base in cosmetic and perfumery industries and hence the phrase "no perfume without jasmine". The dried flowers are used for making the famous 'jasmine tea', scented with aroma from jasmine blossoms, which is a popular drink in South East Asian countries. An infusion of jasmine tea is beneficial in treating fever, relieving stress and anxiety. The flowers and other parts of the plant like leaf, stem, bark and root are also used for medicinal purposes [3]. Flower or essential oil, jasmine find a place in useful medicines as an aphrodisiac, sedative, antiseptic, antidepressant, antispasmodic, and analgesic relieving pains and relaxing the nervous system [4,5]. There are many factors that affect jasmine production, of which pest incidence takes major lead. Among the arthropods attacking jasmine, jasmine leaf webworm, *Nausinoe geometralis* is one of the prime pests which devastates the productivity of the crop. In view of this, it is of prime importance to monitor the population buildup of leaf webworm as influenced by weather factors, so that suitable management strategy could be taken up when such a favourable climatic change occur besides forecasting the likelihood of occurrence of leaf web worm incidence. With this idea, field investigations were conducted in two different climatic zones of Tamil Nadu, Madurai and Coimbatore district.

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Materials and Methods

Field investigations were carried out in two different agro climatic regions *viz.,* Coimbatore and Madurai district to assess the seasonal fluctuation or temporal variation of jasmine leaf web worm in local variety of jasmine "Ramnad Local' at Agricultural College and Research Institute, Madurai and Botanical Garden premises, Tamil Nadu Agricultural University Coimbatore-3. The leaf web worm incidence was recorded on five randomly selected plants per plot at fortnightly interval, continuously for one year (June 2015 – May 2016). The percent incidence was calculated by recording the total number of leaves and the leaves skeletonized/webbed by the leaf webworm. The mean incidence of jasmine leaf webworm was correlated with the following weather parameters *viz.,* maximum and minimum temperature, sunshine hours, rainfall, relative humidity and wind velocity. The weather data of Madurai and Coimbatore district was collected from the Meteorological observatory of Department of Agronomy, Agricultural College and Research Institute, Madurai and Tamil Nadu Agricultural University Coimbatore-3.

Results and Discussion

The data of the population load in each month was correlated with weather parameters and the linear regression equation was fitted to know the degree and extent of influence of the weather factors on the population build up of jasmine leaf webworm, *Nausinoe geometralis*. Early instar larva scraps the parenchymatous matter on the lower surface of the leaf lamina. The matured larva web the adjacent leaves and nibbled to make holes in the leaves which are quite often reduced to mere veins. All different life stages could be seen feeding a single leaf in a gregarious manner. The severely attacked bush presented a 'burnt appearance' as the damaged and dried leaves and faecal pellets remain entrapped in the web resulting in reduced vitality of plant. Similar nature of damage and distribution of leaf webworm, *N. geometralis* on jasmine was previously noticed by workers [6].

The study revealed that the occurrence of jasmine leaf webworm, *Nausinoe geometralis* was less severe in winter months, ie from December till March in both the investigated region due to the prevalence of moderate temperature and RH, along with receipt of frequent and sharp showers (Table 1). The leaf webworm incidence varied from 14.62 to 20.14 percent from December till March with the lowest percent incidence of 14.62 percent in the month of December in Madurai District. It is evident that the leaf webworm incidence reached its peak during September (27.65 percent) followed by October (29.75 percent) and November months (28.45 percent), owing to the declining of summer. The incidence of jasmine leaf webworm started to raise with the onset of summer months and reached peak at the outset of summer. The peak population of leaf webworms started from September month (12.46 leaf webworms per 2 cm^2 area), with sharp decline in November, December and January (5.28, 4.30 and 3.64 leaf webworms per 2 cm^2 area). The scenario was same for the number of larvae per plant with the peak population at the month of October (6.30 larvae/plant). This finding were in confirm action with the findings of earlier workers [7, 8] who corroborated the maximum incidence of leaf webworm, *N. geometralis* on jasmine in summer months with steady decrease in winter months (Fig 1).

The incidence of jasmine leaf webworm, *Nausinoe geometralis* also showed a similar trend in Coimbatore district. The maximum occurrence was recorded in the month of October (26.54 percent), November (25.68 percent) and September (24.36 percent) and minimum occurrence in the month of December (12.75 percent). The population started increasing with the onset of summer months recording 20.65, 21.41 and 20.65 percent incidence in April, May and June months. However, the leaf webworm incidence started declining further with the onset of monsoon and heavy rainfall in June month (19.41 percent) and furthermore in July month (17.45 percent) and again the population rebound in August (20.24 percent) and reached maximum in October (26.54). The population again started decline with the onset of mist in winter months. Reports corroborated that the leaf webworm population became significant from April which is in conformity with the present study [9] (Fig 2). A similar trend with reference to population dynamics of *N. geometralis* in Jasmine was reported earlier [10].

Simple correlation and multiple regression were worked out to study the influence of weather parameters like maximum and minimum temperature, relative humidity, rainfall, solar radiation and wind velocity over the incidence of jasmine leaf webworm, *N. geometralis* during June 2015 to May 2016 at Madurai (Agricultural college and research Institute, Madurai) and Coimbatore (The Botanical garden premises, TNAU) and the data were presented in Table 2 and 3. The jasmine leaf web worm incidence were also positively correlated for maximum temperature (r = +0.395) and (r= +0.304) and negatively for relative humidity (r=-0.294) and (r= -0.338) and rainfall (r= -0.368) and (r=-0.334) in Madurai and Coimbatore districts respectively. Moreover, the incidence was positively corelated with sunshine hours (r = +0.101) and (r= +0.218) and negatively with wind velocity (r= -0.366) and (r=-0.154) in both the investigated districts *viz.,* Madurai and Coimbatore districts. Similar results were obtained by workers [8], that phytophagous leaf webworm, *N. geometralis* showed a significant positive correlation with maximum temperature and negative correlation with Relative humidity and rainfall. It was also proved beyond doubt that the population of *N. geometralis* had a significant positive correlation with maximum temperature and significant negative correlation with rainfall and Relative Humidity. Similar results, reported [7, 11], who supported that both maximum as well as the minimum temperatures were positively correlated with leaf webworm population. Rainfall caused a wash out effect over the leaf webworm population significantly reducing their spread and intensity of damage and could observe a drastic decrease in incidence and population in rainy period (Table 3).

From the multiple linear regression analysis between weather parameters and abundance of leaf webworm, *Nausinoe geometralis* it is evident that the maximum temperature (T_{max}) and minimum temperature (T_{min}) had significant contribution towards the abundance of leaf web worm with the R^2 value 0.745 and 0.214 in Madurai and Coimbatore districts with 1°C increase in maximum temperature (T_{min}), leaf webworm population increased by 1.468 and 0.272 percent whereas, with 1°C decrease in minimum temperature (T_{min}), leaf webworm population decreased by 0.551 and 0.518 respectively in Madurai and Coimbatore districts. Nevertheless, an increase in RH by one percent there was a decrease in leaf webworm population by 1.095 and 0.407 number in both districts respectively. The increase in sunshine hours by 1 hour increased by the leaf webworm number by 0.284 and 1.456 in both the districts and an increase in wind

velocity by 1 km/hr boosted the leaf webworm population significantly by 0.817 and 0.485 numbers.

Table 1: Influence of weather factors on population dynamics of leaf webworm, *Nausinoe geometralis* in Jasmine eco-system (June 2015 to May 2016)

Month	Madurai District		Coimbatore District	
	No. of larvae/plant	Percent leaf webworm incidence	No. of larvae/plant	Percent leaf webworm incidence
June	5.20[cd]	21.65[c]	4.70	19.41
July	4.60[b]	19.36[b]	4.30	17.45
August	3.40[f]	16.26[e]	3.10	20.24
September	5.90[ab]	27.65	5.30	24.36
October	6.30[a]	29.75[a]	5.90	26.54
November	5.70[c]	28.45[c]	5.60	25.68
December	2.60[f]	14.62[f]	2.40	12.75
January	3.50[e]	19.65[d]	3.30	18.63
February	3.70[c]	20.14[bc]	3.60	19.42
March	4.10[a]	21.65[a]	3.90	20.65
April	4.90[cd]	21.65[c]	4.20	21.41
May	5.10[b]	22.36[b]	4.60	20.65

Table 2: Correlation between weather parameters on seasonal abundance of leaf webworm, *Nausinoe geometralis* in Jasmine eco-system in Madurai and Coimbatore district during 2015-2016

Weather parameters	Correlation coefficient	
	Madurai District	Coimbatore District
Maximum temperature (T_{max}) (°C)	0.395 [NS]	0.304[NS]
Minimum temperature (T_{min}) (°C)	0.430 [NS]	0.041[NS]
Relative humidity (%)	-0.294[NS]	-0.338[NS]
Rainfall (mm)	-0.368[NS]	-0.334[NS]
Sunshine (hrs)	0.101[NS]	0.218[NS]
Wind Velocity(Km/hr)	-0.366[NS]	-0.154[NS]

Correlation coefficient is significant at 0.05 % level (one-tailed)

Table 3: Multiple linear regression analysis for the prediction of leaf webworm, *Nausinoe geometralis* in Jasmine eco-system in Madurai and Coimbatore district during 2015-2016

Variables	Regression Coefficient	
	Madurai District	Coimbatore District
Intercept (a)	14.75*	49.179
Maximum temperature (T_{max})(°C)	1.468*	0.272
Minimum temperature (T_{min}) (°C)	0.551	0.518
Relative humidity (%)	-1.095*	-0.407
Rainfall (mm)	0.3056	-2.702
Sunshine (hrs)	-0.284	-1.456
Wind Velocity(Km/hr)	-0.817*	-0.485
R^2	0.745	0.214

Regression equations

1. $Y_1 = 14.75^* + 1.468^* X_1 + 0.551 X_2 - 1.095 X_3 + 0.3056^* X_4 - 0.284^* X_5 - 0.817^* X_6$
2. $Y_2 = 49.17^* + 0.272 X_1 + 0.518 X_2 - 0.407 X_3 - 2.702^* X_4 - 1.456^* X_5 - 0.485 X_6$
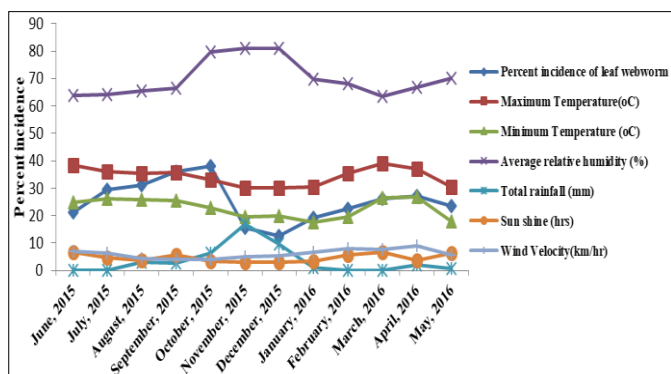

Fig 1: Influence of weather parameters on seasonal abundance leaf webworm, *Nausinoe geometralis* in Madurai district
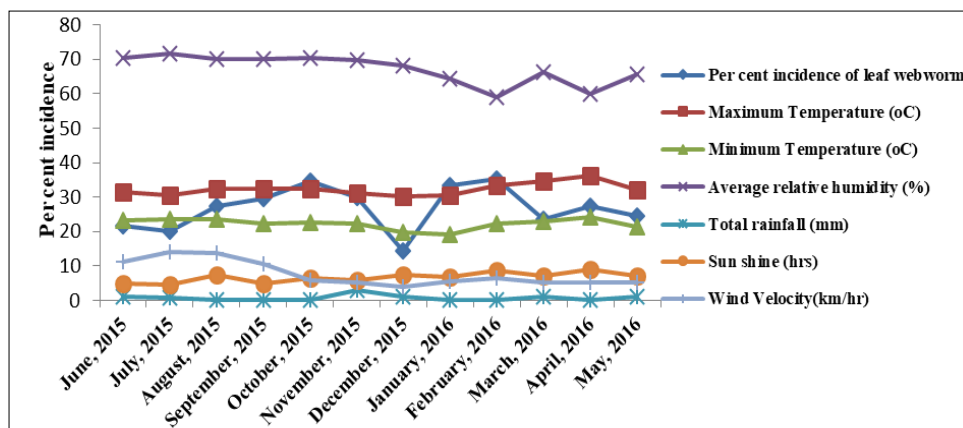

Fig 2: Influence of weather parameters on seasonal abundance of leaf webworm, *Nausinoe geometralis* in Coimbatore district

Conclusion

The influence of weather parameters on jasmine pest population is immensely needed for chemical interventions. There is a sudden decrement in the leaf webworm population in December and January. In winter months, flower production is very low due to mist damage and hence most gardens are pruned and hence there is less access to food. Moreover, leaf webworms require hot weather for their survival and hence their population is inevitable in cooler months. Similar reports were previously reported [6, 9, 12]. The positive correlation with maximum temperature shows that the scope of buildup of jasmine pests with the increase in temperature which demands timely intervention to check the population. On the contrary, negative correlation with rainfall highlights the natural reduction of pest population.

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