MITE OCCURRENCE IN *Lantana camara* FLOWERS

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RESUMO

Ocorrência de ácaros em flores de *Lantana camara* – *Lantana camara* é um arbusto perene com interesse agronômico pois se trata de planta invasora principalmente de pastagens quando em estado selvagem e uma bela planta ornamental em suas variedades/cultivares cultivadas. Suas flores são polinizadas por borboletas que são vistas visitando-as freqüentemente e por abelhas e beija-flores. A polinização cruzada é necessária nesta planta para ocorrer formação de frutos e sementes, estas últimas sendo seu principal mecanismo de reprodução. No corpo desses polinizadores vivem em foresia ácaros das ordens Mesostigmata e Astigmata que "tomando carona" chegam às flores de lantana, quando aqueles polinizadores visitam essas plantas. A distribuição de ácaros nessas flores é significativamente afetada por fatores como a temperatura e a umidade relativa do ar, pois os ácarossão muito sensíveis ao dessecamento em condições de alta temperatura e baixa umidade relativa. A freqüência relativa de ácaros em flores vermelhas foi nove vezes maior que em flores amarelas, em flores alaranjadas e rosas, esta freqüência foi próxima de cinco vezes maior que em flores amarelas. Isto está relacionado ao comprimento da corola das flores de lantana, mais longa em flores vermelhas e rosas e mais curtas em flores amarelas.Os ácaros consomem 40% do volume de néctar das flores, reduzindo a disponibilidade deste alimento aos polinizadores, que evitam visitar flores cujo néctar foi parcialmente consumido. Isto reduz a produção de sementes, mas também obriga os polinizadores a visitar plantas diferentes, promovendo a fecundação cruzada. Assim, os ácaros foréticos têm um duplo papel na reprodução de lantana, podendo ser considerados pragas bem como organismos benéficos, dependendo se se trata de lantana cultivada ou em estado selvagem. Os Mesostigmata sendo predadores, por outro lado, tem papel benéfico como biocontroladores de pragas.

Palavras-chave: Mesostigmata, Astigmata, polinização, foresia, lantana

ABSTRACT

MITE OCCURRENCE IN *Lantana camara* L. FLOWERS

Lantana camara is a perennial shrub with agronomical interest as it is a weed mainly of pastures in wild state and it is a beautiful ornamental plant in its cultivated varieties/cultivars. Its flowers are pollinated by butterflies which are often seem visiting them, and by bees and hummingbirds. Cross pollination is needed in this plant for fruit and seed set, this latter being its main reproductive mechanism. On the body of these pollinators mites of the orders Mesostigmata and Astigmata live in phoresy and by hitch-hiking arrive to lantana flowers, when those pollinators visit these plants. Mite distribution in these flowers is significantly affected by factors such as temperature and air relative humidity, as mites are sensible to dessication under high temperature and low relative humidity conditions. Relative frequency of mites in red flowers was nine times higher than in yellow flowers, in orange and pink flowers, this frequency was close to five times higher than in yellow flowers. This is related to the lantana flower corolla length, longer in

red and pink flowers and shorter in yellow flowers. Mites consume 40 % of flower nectar volume, reducing the availability of this food to pollinators, which avoid visiting flowers which nectar was partially consumed. This reduces seed production, but also obliges the pollinators to visit different plants, promoting cross fecundation. Thus the phoretic mites have a double role in lantana reproduction, so they may be considered pests as well as beneficial organisms depending on the cultivated lantana or wild state ones. The Mesostigmata being predatory on the other side has another beneficial role as pest biocontrollers.

Key words: Mesostigmata, Astigmata, phoresy, pollination, lantana

INTRODUCTION

Originated from Central and South America (Lorenzi and Souza, 2004), *Lantana camara* L. is a perennial shrub which reaches up to 1.5 m high, presenting dense ramification and heary, harsh leaves (Bacchi et al., 1984). The variously colored flowers, can be orange, yellow, white, purple, pink or red or with changing color according to age, are assembled in inflorescences (Bacchi et al., 1984; Lorenzi and Souza, 2004) and measure up to 2 cm in length (Weiss, 1991; Lorenzi and Souza, 2004).

It is a plant with agronomic interest, because in wild state is a pastureland weed with toxic effect to livestock (Lorenzi, 1991. Fenshan et al., 1994; Swarbrick and Wilson, 1995). When cultivated in its hundreds of varieties/cultivars, which can belong to the species *Lantana camara* or hybrids between *L. camara* and *L. montevidensis* are showy ornamental plants (Lorenzi and Souza, 2004). Under weed conditions, in the original region as well an in regions where it had been introduced, lantana has been object of biological control, with 36 insect species and 5 fungi species (Thomas and Ellison, 2000) tested as possible control agents.

Bees (Goulson and Derwent, 2004), butterflies (Schemske, 1976; Boggs and Gilbert, 1987) and humming birds (Colwell, 1979; 1985; Feinsinger et al., 1986; Colwell and Naeem, 1999) are lantana flower pollination agents. Among these plants selfing can occur, but cross pollination is needed for maximization of fruit and seed set, and these latter are its main reproductive mechanism (Barrows, 1976; Goulson and Derwent, 2004). Lantana flowers are visited by the following butterfly species: *Agraulis vanillae, Anastia fatima, A. jatrophae, Danaus plexippus, D. gilippus, Eurema daira, Lycorea ceres, Urbanus sp.* And some butterfly species belonging to Hesperiidae and Pieridae families under Costa Rica conditions, during March (Barrows, 1976). Humming birds and butterflies compete for flower nectar as these birds are seem scaring these insects (Primack and Howe, 1975) as well as bees scaring humming birds (Irwin and Brody, 1998).

Mites are non-winged arthropods; their dissemination in the environment is made by wind, a passive process that allows their distribution over wide areas, by walking on their feet or by phoresy. Phoresy is defined as a form of commensalism, where one of the organisms (the phoretic organism) adheres to the body of the other (the phoretic host) and is transported by the latter among the plants where "disembarks", and with respect to this aspect it is a special form of migration (Binns, 1982; O'Connor, 1982; Houck and Connor, 1991). The mites of the order Astigmata are phoretic in butterflies, moths, bees (Houck and O'Connor, 1991) Coleoptera (O'Connor, 1982; Houck and O'Connor, 1991), humming birds (Colwell, 1979; 1985. Naeem et al., 1985) mammals (Houck and O'Connor, 1991). Phoresy is also observed among the mites of the order Mesostigmata (Boggs and Gilbert, 1987; Colwell, 1995; Naeem et al., 1985). Phoretic mites adhere to specific parts of the host bodies as butterfly proboscis and head (Houck and O'Connor, 1991; Boggs and Gilbert, 1987) and humming bird's nares (Colwell, 1979; 1985). The mite *Proctolaelaps lobata* De Leon (order Mesostigmata) is specific of lantana flowers and is phoretically transported by butterflies and prefers to disembark in flowers opened on the day, where it occurs in higher number (Boggs and Gilbert, 1987). Mites of the genera *Rhinoseius* and *Tropicoseius*, phoretic in humming bird nares are distributed among lantana flowers by these hosts (Colwell, 1979. 1995; Naskrecki and Colwell, 1998; Colwell and Naeem, 1999; Soroker et al., 2003). These mites live and reproduce in lantana flowers and feeding on pollen and nectar (Colwell, 1979; 1995; Colwell and Naeem, 1999).

Mites can consume up to 40% of nectar volume of the plant *Hamelia patens;* including the humming birds it is consumed 85% of the nectar volume. As the mites consume considerable proportion of the nectar, they can be considered as pest, as they reduce nectar availability for the pollinators (butterflies and humming birds) and render the flowers less attractive to this agents (Colwell, 1995). The pollinators not visiting the flowers with partially consumed nectar, it will occur reduction in fruit and seed set. Conversely, this fact can also be beneficial to plants, as this obliges the pollinators to visit different plants, promoting cross pollination, what as previously seem, is needed for fruit and seed set in lantana (Irwin and Brody, 1998; Maloof and Inouye, 2000). The Mesostigmata can also be considered beneficial as they are pest predators. Provided the economic interest of lantana (as weed to be controlled or ornamental to be cultivated) and the double role of its mites, this paper has as objective to analyze the contribution of biotic and abiotic factors affecting these arthropod distribution among lantana flowers.

MATERIALS AND METHODS

Lantana camara inflorescences of the colors orange, yellow, white, pink and red were collected in Embrapa Meio Ambiente gardens,on sunny and clouded days, during the morning (8:00 h) and afternoon (14:00 h) periods. Collection of inflorescences with different color florets was avoided, as in these cultivars occurs flower color change according to age, and this fact affects the pollinators' behavior (Weiss, 1991). The inflorescences were placed in plastic containers (Sanremo) with water to avoid wilting and examined at Entomology Laboratory. Samples of 50 florets of each color were taken, which were cut along their length one by one by using a blade (Gillette Co.) and the number of mites existing in each floret counted under stereomicroscope (Carl Zeiss, Germany) with 10 and 25 times magnification. The mites were collected and conserved in 70% ethanol and sent to Dr. Gilberto José de Moraes from Zoology Departament, ESALQ/USP, for identification.

The obtained results were firstly utilized for contruction of contingency tables, to test data homogeneity. After the statement of heterogeneity, correlation analysis with physical environment factors – temperature (o C), air relative humidity (%) and solar radiation (W) – prevailing at the inflorescence collection time was made, and correlation coefficients r were estimated.

In order to visualized and to compare the mite number found by its set of data, histograms were constructed for each period and weather conditions. To find out the reasons by which different number of mites are found according to flower color, samples of 20 florets of each color were taken and their corolla length measured because there is this dimension variation among the different colors and probable preference of the mites for different length flowers. The observed mean length of each color was correlated with mite number, and correlation coefficient r estimated. To test the significance of r coefficients it was applied Student's t test to them and their respective probabilities estimated.

RESULTS AND DISCUSSION

The results of homogeneity test are in the tables 1 and 2. The mite relative frequencies were significantly heterogeneous (χ^2 = 14,3258; p = 0,0063) for mites found in different colors florets during the morning period. The same study applied for the afternoon period, the probability to be homogeneous was low (χ^2 = 9,2623; p = 0,0549). Mite relative frequencies depend upon the lantana flower color, suggesting that there is some factor linked to flower color affecting these frequencies.

Table 1. Relative frequencies of mites in *Lantana camara* flowers of different colors, On sunny and clouded days; morning period

Weather	n	color					Total
	Freq.	Orange.	Yellow	White	Pink	Red	
Sunny	n	14	4	6	28	58	110
	%	12,73	3,64	5,45	25,45	52,73	
Clouded	n	28	4	11	13	39	95
	%	29,47	4,21	11,58	13,68	41,05	
Total		42	8	17	41	97	205

Statistics	Degree of freedom	Value	Probability
Chi-square	4	14,3258	0,0063

Table 2. Relative frequencies of mites in *Lantana camara* flowers of different colors, On sunny and clouded days; afternoon period

Weather	n	color					Total
	Freq.	Orange	Yellow	White	Pink	Red	
Sunny	n	9	4	2	19	14	48
	%	18,75	8,33	4,17	39,58	29,17	
Clouded	n	16	2	3	6	15	42
	%	38,10	4,76	7,14	14,29	35,71	
Total		25	6	5	25	29	90

Statistics	Degree of freedom	Value	Probability
Chi-square	4	9,2623	0,0549

Table 3 shows physical environment factors values – temperature (o C), air relative humidity (%) and solar radiation (W) for flowers of different colors, during the morning and afternoon periods and on sunny and clouded days, prevailing at the inflorescence collection time. Table 4 presents the correlation coefficients r's found for the relation between physical environment factors and observed mite number, with Student's t test results and respective probabilities. Negative correlation with temperature was observed for all flower colors; positive correlation with relative humidity, except for pink flowers. The r coefficient of correlation with the temperature (- 0.9671) was significant ($p < 0.05$) for mites found in white florets; for orange (- 0.9309) and red flowers (- 0.9034) the significance was placed between the probabilities $0.05 < p < 0.10$. With respect to the correlation with relative humidity only the r coefficient of correlation for mites found in orange florets (0.9758, $p < 0.05$) was significant. The r coefficient of correlation with solar radiation were not significant ($p > 0.10$) for all floret's colors. These results suggest that the incidence of mites is affected by temperature and relative humidity. This is due to the fact that as mites are exposed to desiccation under conditions of high temperature (negative correlation) and low air relative humidity (positive correlation).

Table 3. Mite incidence in *Lantana camara* flowers of different colors and physical environment factors.

Corolla Color	Period Weather	No.of mites	Temperature (o C)	Relative humidity (%)	Solar radiation (W)
Orange	SM	14	25,5	71,0	469,3
	SA	9	31,5	49,5	1038,0
	CM	28	20,9	96,3	105,9
	CA	16	27,9	69,2	200,4
Yellow	SM	4	24,3	76,9	451,1
	SA	4	31,5	49,5	1038,0
	CM	4	20,9	96,3	105,9
	CA	2	32,5	50,7	910,0
White	SM	6	24,3	77,0	451,0
	SA	2	28,2	41,0	310,1
	CM	11	20,9	96,3	105,9
	CA	3	25,6	79,0	409,2
Pink	SM	28	25,3	66,4	488,5
	SA	19	30,7	49,4	1018,0
	CM	13	24,9	80,1	369,3
	CA	6	27,9	69,2	200,4
Red	SM	58	25.3	66,4	498,5
	AS	14	30,7	49,4	1018,0
	CM	39	24,9	80,1	369,3
	CA	15	31,2	59,1	966,0

SM = Sunny morning; SA = Sunny afternoon
CM = Clouded morning; CA = Clouded afternoon

Table 4. Correlation coefficient r between the mite incidence in *Lantana camara* flowers and temperature (° C), relative humidity (%) and solar radiation (W) with respective t test results and their probabilities.

Corolla Color	Temperature (o C)	t	P	Relative humidity (%)	t	P	Solar radiation (W)	t	P
Orange	- 0,9309	- 3,6041	0,05<p<0,10	0,9758	6,3110	< 0,05	- 0,8188	- 2,0171	> 0,10
Yellow	- 0,6172	- 1,1094	> 0,10	0,5225	0,8667	> 0,10	- 0,4412	- 0,6953	> 0,10
White	- 0,9671	- 5,3762	< 0,05	0,8066	1,9298	> 0,10	- 0,6967	- 1,3735	> 0,10
Pink	- 0,1650	- 0,2366	> 0,10	- 0,3370	- 0,5062	> 0,10	0,4944	0,8044	> 0,10
Red	- 0,9034	- 2,9795	0,05<p<0,10	0,6256	1,1643	> 0,10	- 0,8646	- 2,4335	> 0,10

$t_{0,05}$ = 4,30 (D. F. = 2)
$t_{0,10}$ = 2,92 (D. F. = 2)

Table 5. Length of *Lantana camara* flowers of different colors (mm)

N. of observation	Orange	Yellow	White	Pink	Red
1	15,0	13,5	14,0	18,0	16,0
2	15,0	12,0	13,5	16,0	17,0
3	15,0	12,0	14,0	17,5	17,5
4	15,5	14,0	13,0	18,0	17,5
5	16,0	13,5	14,0	17,5	17,0
6	14,5	14,0	13,5	18,0	16,0
7	16,0	12,0	14,0	17,0	16,0
8	16,0	12,5	13,0	17,5	17,0
9	16,5	13,0	14,0	16,0	17,5
10	16,0	14,0	13,0	16,5	17,5
11	15,0	13,0	14,0	16,0	17,0
12	14,5	14,0	14,0	17,5	17,5
13	15,0	13,5	14,0	18,0	16,0
14	14,0	13,5	13,5	16,0	16,0
15	14,0	13,0	13,5	17,5	16,0
16	14,5	14,0	14,5	16,5	16,5
17	16,0	13,5	14,0	16,0	17,0
18	14,0	13,0	13,5	16,0	16,5
19	15,0	14,0	13,5	17,5	16,5
20	16,0	14,0	14,5	17,5	17,5
Mean	15,18	13,30	13,75	17,03	16,78
Median	15,25	13,00	13,75	17,00	16,75
N. mites	16,8	3,5	5,5	16,5	31,5

Coefficient of correlation = r = 0,8474
T = 2,7643
0,05 < P < 0,10

$t_{0,05}$ = 3,18 (D. F. = 3)
$t_{0,10}$ = 2,35 (D. F. = 3)

It was observed that in red florets it was found the highest mite number (mean 31.5 mites/50 florets), followed by orange florets (mean 16.8 mites/50 florets) and pink (mean 16.5 mites/50 florets) and the lowest number in yellow florets (mean 3.5 mites/50 florets). Thus in red florets it was observed number of mites that is 9 times higher than the number of mites in yellow florets. In orange and pink florets, 5 times higher than in yellow florets. In comparison with white florets (mean 5.5 mites/50 florets) the red florets presented mite number which is 6 times higher, and the orange and pink florets almost 3 times higher.

Table 5 shows the lengths in mm of 20 floret samples of different colors. The means were near the medians, having inclusive coincidence as in the case of white flowers (13.75 mm). The pink flower presented the highest length (mean 17.03 mm) followed by red florets (16.78 mm) and the yellow flowers presented the smaller length (mean 13.3 mm). It was obtained the correlation coefficient between the floret length and the mite number 0.8474, which t test probability was between 0.05 p < 0.10, being low. The incidence of mites is related to florets length, being the highest length (red and pink florets) the preferred by the mites.

The identified mites belong to the orders Astigmata and Mesostigmata and many of their species are phoretic in humming birds and butterflies as is the case of *Proctolaelaps* mites (order Mesostigmata) and coleoptera (Kinn, 1971; Houck and O'Connor, 1991) and provided the fact that butterflies had been observed in abundance visiting the lantana gardens of Embrapa Meio Ambiente, it suggests that the mites reach the flowers phoretically. Although seldom hummingbirds are not been observed visiting lantana flowers, there were found Laelapidae and Ascidae families mites (order Mesostigmata) which are phoretic in the nares of these birds.

CONCLUSIONS

There is correlation between mite occurrence and temperature and relative humidity, what can be explained by desiccation risk to which mites are exposed at high temperature and low relative humidity.

The higher mite occurrence in red flowers is related to floret's length, higher in florets of this color.

Mesostigmata and Astigmata mites reach the lantana flowers of these gardens traveling in phoresy on the butterflies and humming birds bodies.

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