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Distribution and spreading pattern of sugarcane woolly aphid, *Ceratovacuna lanigera* Zehntner in sugarcane fields

A. MALATHI, ZADDA KAVITHARAGHAVAN*, C. VIJAYARAGHAVAN and R. BALAGURUNATHAN

Department of Agricultural Entomology, Tamil Nadu Agricultural University,
Coimbatore 641003, Tamil Nadu, India.
Email: kavitha_j_v@yahoo.com

ABSTRACT: Sugarcane woolly aphid (SWA), *Ceratovacuna lanigera* Zehntner (Hemiptera: Aphididae) has been recorded as serious pest in the sugarcane growing belts of Tamil Nadu. Distribution pattern and mode of spread of woolly aphid and its natural enemies showed that initial influx of SWA on sugarcane commenced on 105 days after planting. The predator, *Dipha aphidivora* appeared on 119 days after planting. Maximum temperature and sunshine hours were positively correlated with the spread of the aphid, while relative humidity (%) (evening) and rainfall showed negative correlation. Colonization of the aphid was intense between September'05 and January'06 except in October'05 in which, number of *D. aphidivora* was noticed thus proving the efficiency of the predator against aphid. The occurrence of another predator, *M. igorotus* followed the same trend at a lower level of population. The abundance of the predators was found to be independent of weather factors, thus can act against SWA efficiently at various environmental conditions. The spread of the aphid within the field was in a spiral manner. Initially, the aphid colonization was influenced more by certain abiotic factors and when colonies had established, the spread was influenced mostly by biotic forces, particularly *D. aphidivora*. SWA and its natural enemies preferred the top leaves of the canopy followed by middle and bottom leaves.

KEY WORDS: *Dipha aphidivora,* distribution, *Micromus igorotus,* spreading pattern, sugarcane woolly aphid.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the important commercial crops in the tropics and serves as the main source of sugar in the world. In Tamil Nadu, sugarcane is cultivated in 316440 hectares with a productivity of 109t ha^{-1}. Sugarcane production in India is always under threat from pests and diseases. Sugarcane woolly aphid (SWA), *Ceratovacuna lanigera* Zehntner (Hemiptera: Aphididae) has created havoc recently in the sugarcane growing belts of Tamil Nadu and become a nightmare for cane farmers. There is an urgent need for evolving a suitable management strategy for this pest and for this, detailed understanding of the ecology of the insect and the mode of its spread in the field is necessary. Biological control is always an important component of an integrated pest management strategy.In sugarcane, two predators, *Dipha aphidivora* and *Micromus igorotus*, were found to be very effective against this aphid. Given this background, the present study was undertaken to find out the distribution pattern and mode of spread of woolly aphid and its natural enemies in the field.

*Corresponding author

MATERIALS AND METHODS

Distribution of sugarcane woolly aphid was studied in an unprotected sugarcane (CV: CO86032) field in Vedapatti village of Coimbatore district. The experiment was initiated when the crop was three months old. The spread of aphid was studied within the leaf, plant and field following the initial influx.

Spread within the leaf

Thirty clumps were selected at random in a field of 2.6ha for observation. From each clump, a tiller and from each tiller, a single leaf with one founder colony of aphid, were selected and tagged. Initially, the length of the founder colony was measured. Later, the length of increase of the aphid colony in the absence of the predator was recorded at weekly intervals for two months. During the observation, the leaf was also observed for the presence of predators and if present, they were removed to avoid their colonization in the selected leaves.

Spread within the plant

The observations were carried out on thirty clumps selected randomly in an area of 2.6ha. From each clump, one tiller was selected and from top, middle and bottom portions of the selected tiller, the number of aphid infested leaves and natural enemies present were noted. Population data of SWA and the natural enemies were correlated with weather parameters (data on maximum temperature, minimum temperature, wind velocity, relative humidity, rainfall and sun shine hours during the observation period were collected from the Agricultural Meteorology Department, TNAU, Coimbatore).

Spread within the field

The study on spreading pattern of SWA in the field from plant to plant after the commencement of initial incidence was initiated in three months old crop. A square plot of 12 x 12m with ten rows and eight to nine clumps per row was demarcated in the centre of the field of 2.6ha and all the clumps were observed daily for the appearance of SWA colony. When the founder colony was observed, the spot was tagged and the spread of the aphid from that spot in different directions was observed at weekly intervals for a period of five weeks (November’05 to December’05). The observations were mapped to understand the spreading pattern of the aphid in the field.

RESULTS AND DISCUSSION

Spread within the leaf

Observations recorded on the incidence of the aphid showed that the initial influx commenced on 105 days after planting (DAP) under unprotected conditions. During the first five weeks, the aphid colony increased in length from 0.4 to 29.00cm linearly on the vertical surface of the leaf blade (Table 1). At the end of the eighth week, the length was 60.2cm. Simple correlation between the weather parameters and the spread of aphid within the leaf showed maximum temperature and sunshine hours were positively correlated with the spread. However, Cheng *et al*., (1992) reported an increase in the length of colony with decrease in temperature. Relative humidity (%) (evening) and rainfall showed negative correlation with the spread of the aphid and the former was more strongly correlated than the latter. Wind speed and relative humidity (%) (morning) had no influence on the spread of the aphid (Table 2).

Spread within the plant

Incidence of the aphid commenced on 105 DAPS in the field. The predator, *Dipha aphidivora*, appeared on 119 days after planting after the aphid. With the increase in aphid population, the number of the predator also increased and the predator exercised much control over the pest. It was observed that leaves with more number of *Dipha* larvae had fewer aphids. Colonization was intense between September’05 and January’06 except in October’05. However, in October, more number of *D. aphidivora* (23.61 larvae tiller^{-1}) was noticed. Almost a similar trend was observed with *M. igorotus*, however at a low level ranging from 1.26 to 1.51 grubs tiller^{-1} (Table 3). *D. aphidivora* outnumbered *M. igorotus* throughout the season. The abundance of predators was found to be independent of weather factors.

Table 1. Spreading distance of SWA within the leaf

Week	Length of the aphid colony (cm)*
1	0.4
2	3.0
3	9.3
4	20.3
5	29.0
6	37.2
7	47.1
8	60.2

*Mean of 30 observations

Table 2. Correlation between the spreading distance of SWA and weather parameters

Weather Factors	‘r’ value
Max Temp (°C)	0.448*
Min Temp (°C)	0.777**
RH (%) (morning)	-0.325^{NS}
RH (%) (evening)	-0.763**
Rain fall (mm)	-0.562**
Wind speed (Kmph)	0.059^{NS}
Sunshine hours	0.675**

NS – Non-significant; *significant at 5 % level; **significant at 1 % level

The incidence of *Dipha* (Y_D in this equation) was independent of climatic variables like maximum temperature (T_{max}), minimum temperature (T_{min}), relative humidity in the morning (RH_m), relative humidity in the evening (RH_e),

$$Y_D = -3.321 + 0.203\,T_{max} - 0.078\,T_{min} + 0.007\,RH_m - 0.003\,RH_e + 0.004\,\text{Rain} + 0.172\,\text{Wind} - 0.006\,\text{Sunshine}$$

(0.218) (0.668) (0.901) (0.954) (0.515) (0.119) (0.967)

$R^2 = 0.46$ N = 22

$$Y_M = 0.122-0.047\,T_{max} + 0.069T_{min} + 0.008\,RH_m - 0.013\,RH_e + 0.002\,Rain + 0.017\,Wind + 0.006\,Sunshine$$
$$(0.663)\quad(0.574)\quad(0.822)\quad(0.675)\quad(0.603)\quad(0.810)\quad(0.528)$$

$R^2 = 0.17$ N=22

rainfall, wind velocity and sunshine considered in the present study. The R^2 was very low indicating only 46 per cent of the variation in the incidence of *Dipha* was impacted by these climatic variables together. We can conclude that the incidence of *Dipha* is independent of such climatic variables and various other factors encourage the incidence of *Dipha* in sugar cane eco system.

Similar results were obtained in the case of *Micromus* incidence (Y_M) also in the research area. In this case the incidence of *Micromus* was not much impacted by the climatic variable as indicated by the very low R^2 value of 0.17 indicating a 17 per cent variation in the incidence of *Micromus* influenced by these climatic variables. This contributes to the efficiency of the predator against SWA at various environmental conditions.

Spread within the field

Sugarcane woolly aphid incidence commenced on 112 DAPS in the demarcated plot. During the subsequent weeks of observation, new incidences were observed (P_1 to P_4) (Fig 2). However, uninfested areas were also observed indicating non-uniformity in infestation. When the spreading pattern in the field was mapped, it was observed that the aphid spread in a spiral manner and in quick succession (Fig. 1).

Spatial distribution of aphid and its predators

Observations recorded on the number of SWA affected leaves, and its natural enemies in the top, middle and bottom portions of the tiller revealed the preference of the aphid to the leaves in the top portion of the tiller followed by the

Table 3. Incidence of SWA and its natural enemies during September'05-January'06 in Vedapatti village, Coimbatore

Standard week	SWA colonized leaves tiller^{-1} (Nos.)	*D. aphidivora* tiller^{-1} (Nos.)	*M. igorotous* tiller^{-1} (Nos.)
36	6.76	20.83	0.00
37	5.88	16.13	1.02
38	4.96	15.98	0.00
39	5.72	13.65	5.03
Mean (September '05)	5.83	16.65	1.51
40	5.76	23.86	2.25
41	4.98	24.02	2.64
42	4.73	24.15	0.00
43	4.62	25.17	0.00
44	5.52	20.86	1.85
Mean (October '05)	5.12	23.61	1.35
45	4.03	7.25	1.32
46	3.72	8.03	2.34
47	4.28	9.12	0.00
48	4.13	10.16	1.71
Mean (November '05)	4.04	8.64	1.34
49	5.32	11.98	2.42
50	5.63	9.83	0.00
51	4.98	8.06	0.00
52	4.72	9.72	2.63
Mean (December '05)	5.16	9.90	1.26
1	4.73	19.38	2.98
2	6.42	17.63	1.24
3	5.73	15.42	0.00
4	5.85	18.55	1.42
5	5.73	18.72	1.65
Mean (January '05)	5.69	17.94	1.46

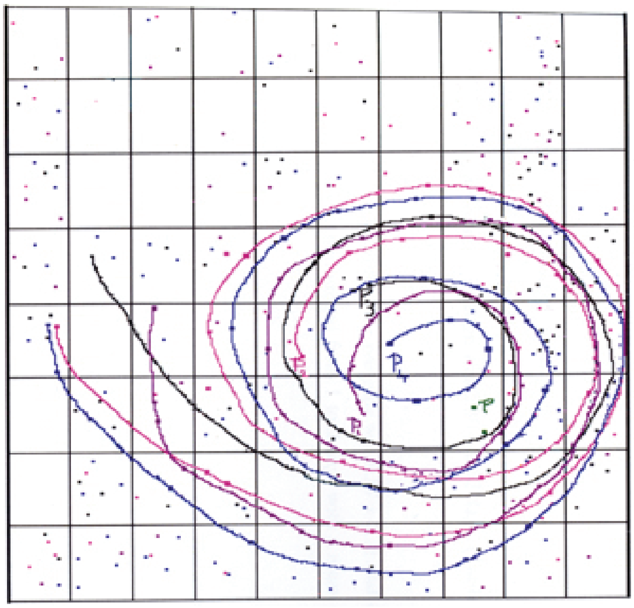

Fig. 1. Spread of SWA within a field patch in unprotected conditions (Vedapatti village, Coimbatore) initial influx II P, 7 days after II P1, 14 days after II P2, 21 days after II P3, 28 days after II P4, Lines indicate the colonization pattern

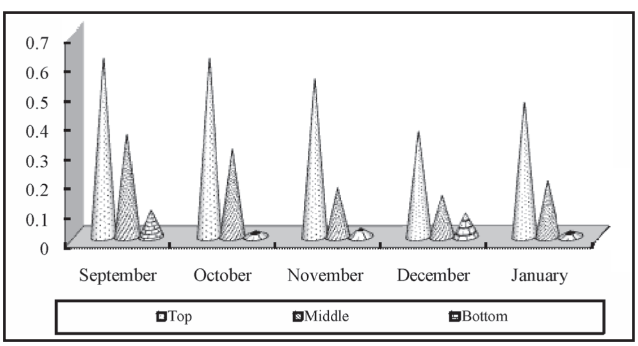

Fig.1a. Spatial distribution of SWA on affected leaves on sugarcane plants

middle and bottom portions (Fig. 2a). The same trend in preference was noticed with the population of *D. aphidivora* (Fig. 2b) and *M. igorotus* (Fig. 2c). This could be due to several factors such as succulence of leaves, nutritional status and favourable physical condition of the leaves.

Initially the aphid colonization was influenced more by certain abiotic factors and when colonies had established, the

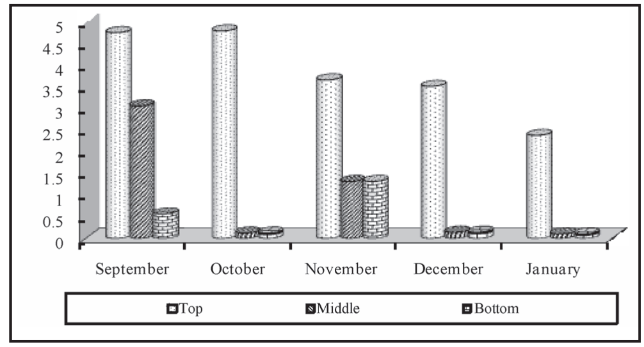

Fig. 1b. Spatial distribution of *D. aphidivora* in relation to SWA infestation

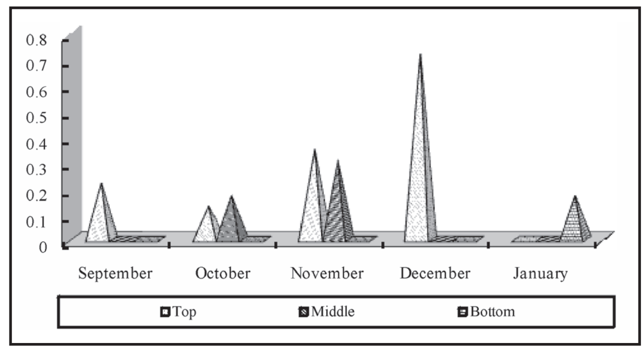

Fig. 1c. Spatial distribution of *M. igorotus* in relation to SWA infestation

spread was influenced mostly by biotic forces, particularly *D. aphidivora*. The asynchrony in the occurrence of the predator could be manipulated through controlled release of *D. aphidivora* in the zones of non-occurrence.

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REFERENCE

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