

Natural Enemies of Sugarcane Woolly Aphid (*Ceratovacuna lanigera*): A Survey in Passara, Sri Lanka

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ABSTRACT

Sugarcane Woolly Aphid (SWA) (*Ceratovacuna lanigera* Zehntner, Homoptera: Aphididae) is a severe sap-sucking pest of sugarcane in Sri Lanka and it destroyed the most of the sugarcane plantations in Badulla district in 2006. Pest status demands environmentally sound control strategy. The objective of this study was to search the natural enemies that could be used in a bio control programme. In addition, population dynamics of natural enemies was also studied. A field experiment was conducted in sugarcane plantations in Passara area of Badulla district from May 2010 to January 2012. Two SWA-infested fields were selected and maintained under insecticide-free conditions for sampling of SWA and its natural enemies.

Natural enemy spectrum of SWA includes only arthropod predators. Parasitoids were not detected during the study period as in other sugarcane growing areas with SWA infestation. *Dipha aphidivora* (Lepidoptera: Pyralidae), *Micromus* sp. (Neuroptera: Hemorabiidae), *Eupeodes* sp. (Diptera: Syrphidae), *Micraspis discolor* (Coleoptera: Coccinellidae), *Synonycha* sp. (Coleoptera: Coccinellidae) and *Micraspis allardi* (Coleoptera: Coccinellidae) were found in samples. *Eupeodes* sp. (Diptera: Syrphidae) and *Synonycha* sp. were found as the natural predators of SWA confined to Passara area. Population dynamics of natural predators during study period showed that *Dipha aphidivora* and *Micromus* sp. are the prominent natural predators. The *Eupeodes* sp. and coccinellid beetles showed an uneven distribution pattern throughout the study period.

Key words: *Dipha aphidivora*, *Eupeodes* sp., *Micromus* sp., Sri Lanka, Sugarcane Woolly Aphid

INTRODUCTION

Cultivation of sugarcane for jaggery/syrup manufacture at cottage level has been a main livelihood of farmers in Passara area of Badulla district, in the Uva Province (670-690 m above sea level) of Sri Lanka for more than 50 years. The area is hilly and sloppy. Numerous local sugarcane varieties including "Alu Uk" were grown in the area under rain-fed conditions. Number of ratoon crops, often even more than twenty five, were maintained successfully with high-quality juice. The average jaggery production of the area was 7,500-10,000 kg/ha. Sugarcane woolly aphid (SWA) (*Ceratovacuna lanigera* Zehntner, Homoptera: Aphididae) was recorded in January 2006 in few scattered sugarcane fields (*Saccharum* spp. hybrid) in the mid country hills of Badulla, Sri Lanka after its first record in 1905 (Kumarasinghe, 2007). In the same year an outbreak of the SWA was occurred severely damaging the sugarcane plantations in Passara area. It badly affected the main livelihood of the people in the area. Most of the sugarcane plantations were completely destroyed upon the severe SWA infestation which in turn badly affected establishment of ratoon crops.

The woolly aphid multiplies very rapidly; it takes 15-20 days to complete the life cycle under favourable climatic conditions; highest RH (80-82%) and lowest sunshine hours (3.2-3.75h) during the North-East monsoon (Kumarasinghe and Basnayake, 2009). It is very difficult to control SWA due to dense cropping of sugarcane as well as woolly mass present on the body of it (Sharanabassapa, 2007). According to Patil *et al.*, (2003), woolly aphid incidence was higher in sugarcane

cultivars with broad and droopy leaves than those with narrow and erect leaves. Almost all the traditional varieties grown in Passara area are with droopy leaves with high sugar content. According to the field observations, these traditional varieties show high susceptibility to woolly aphid infestation than the newly-introduced variety to Passara area, SL 83 06. The dispersal of SWA to the neighbouring plants and fields is occurred in nymphal (apterous forms) and adult (alate forms) stages. In the study area, dispersion through nymphal stages forming balloon like structure is more common than adult stages with wings. Some studies indicated that dispersion through ballooning is evident during severe aphid infestation (>50% of the leaf area was covered with aphids) (Patil *et al.*, 2004).

Application of pesticides was not a common practice among farmers up to 2006 as there were no severe pest occurrences in sugarcane. During the outbreak of SWA Diamethoate (an organophosphate contact insecticide) had been used by farmers to control SWA. Some other chemicals have been used successfully to manage this pest, but it was noticed that woolly aphid reappeared in the same fields after 20 days of chemical application in India (Tripathi and Srikanth, 2003) as well as in Sri Lanka. The Sugarcane Research Institute (SRI) has recommended Actara 25 WG (a foliar-applied insecticide containing the active ingredient, Thiamethoxam) for only spot application (5g/16L water) in severe infestation of sugarcane by SWA. Insecticidal sprays have direct and indirect effects on natural enemies of SWA. Therefore, more emphasis should be given to establish eco-friendly pest management methods by reducing the use of

harmful insecticides to manage this severe pest of sugarcane.

A programme has been implemented by the SRI to rehabilitate the affected sugarcane cultivations to revive the livelihood of the people. In this programme, management of SWA has been undertaken by SRI focussing mainly on biological control. This study aims at detecting natural enemies which can be used as biological control agents in SWA management programme. In addition, population dynamics of natural enemies under natural environment was also studied.

MATERIALS AND METHODS

The study was conducted in the SWA-infested sugarcane plantations in Kahataruppa area in Passara of Badulla district (annual rainfall 1397 mm, average temperature 24.3 ± 5.7 °C) from May 2010 to January 2012. The study involved the collection of natural enemies from selected farmer fields under insecticide-free condition and followed by preservation and identification. After identification, the population dynamics of natural predators were also studied.

Collection and identification of natural enemies of SWA

Insect collections were done in randomly selected two (2) spots (size of each plot 5 m x 5 m) in each farmer field. In each spot three clumps were selected and in each clump two plants were selected. Each sugarcane field was sampled in monthly intervals using several collecting methods such as sweep nets and hand picking.

The leaf samples with aphid colonies were regularly observed in the laboratory of the SRI, Uda Walawe to detect the activities of natural parasitoids throughout the study period.

Collected adult insects were killed in killing bottles and mounted on pins and labelled to indicate location and date. Eggs and immature stages of natural enemies with aphid-infested leaves were reared and when adult emerged they were preserved for identification. Field collected insects were morphologically characterised and identified to the genus level using published literature (MacLeod and Stange, 2001; Mayadunnage *et al.*, 2007; Saleem *et al.*, 2001; Hippa, 1986; Likhil, 2006).

Population dynamics of natural predators of SWA

SWA infested ten plants were randomly selected in each sampling day to count the number of predators to study the population dynamics. The predators were counted using hand lenses for two hours (between 10.00 a.m. and 12.00 noon) at fortnightly intervals from January 2011 to January 2012. The population of natural predators was expressed as number of each predator per ten plants.

RESULTS AND DISCUSSION

Identification of natural enemies of SWA

Natural enemy spectrum of SWA in the study area consisted only natural predators. Parasitoids were not observed during the study period as in other sugarcane growing

Table 1 - Predatory insect species collected from Passara sugarcane plantations (from May 2010 to January 2012)

Scientific Name	Order	Family	Presence	Relative abundance
<i>Dipha aphidivora</i>	Lepidoptera	Pyrilidae	All areas	48
<i>Micromus</i> sp.	Neuroptera	Hemorabiidae	All areas	38
<i>Eupeodes</i> sp.	Diptera	Syrphidae	Passara	7
<i>Micraspis discolor</i>	Coleoptera	Coccinelidae	All areas	2
<i>Micraspis allardi</i>	Coleoptera	Coccinelidae	All areas	3
<i>Synonycha</i> sp.	Coleoptera	Coccinelidae	Passara	2

areas with SWA infestation. Identified natural predators of SWA are listed below (Table 1) and three new species were found as predators of SWA. They are *Micromus* sp. (Neuroptera: Hemorabiidae) (Plate 1; 2a, 2b, 2c), *Eupeodes* sp. (Diptera: Syrphidae) (Plate 1; 3a, 3b, 3c) and *Synonycha* sp. (Coleoptera: Coccinelidae) (Plate 1; 5).

Approximately forty (40) natural enemies including, seven species of parasitoids, thirty species of predators and three species of fungal pathogens have been recorded on *Ceratovacuna lanigera* in the world (Joshi and Viraktamat., 2004). In Sri Lanka, three species of natural predators have been identified as *Dipha aphidivora* (Lepidoptera: Pyralidae), *Micraspis discolor* (Coleoptera: Coccinelidae), *Micraspis allardi* (Coleoptera: Coccinelidae) (Kumarasinghe, 2007). All the natural predators of SWA found in other sugarcane-growing areas were also found in

Kahataruppa in Passara area. The *Eupeodes* sp. And *Synonycha* sp. (Diptera: Syrphidae) were found only in Passara sugarcane plantations in Sri Lanka. Rabindra *et al.*, (2007) stated that the syrphid *Eupeodes confrater* in India found in fairly good numbers in cold seasons. Likhil (2006) revealed that *Eupeodes confrater* was the major predatory species of SWA in Dharwad and Sunkeshwar in India. The average temperature of the study area was 24.3 ± 5.7 °C which is lower than that in other sugarcane growing areas; 28.36 ± 5.35 °C in Uda Walawe, 27.98 ± 4.78 °C in Sevanagala and 30 °C in Pelwatte. This lower temperature might be the reason for the presence of the syrphid, *Eupeodes* sp. in Kahataruppa in Passara area. This is proved by the fact that the rearing of the syrphid predator, *Eupeodes* sp. in the laboratory and in the field cages at Uda Walawe where the average temperature is relatively high, was not successful due to the high mortality of the adult flies.



Plate 1 - Predatory insect species collected from Passara sugarcane plantations (from May 2010 to January 2012)

1 a: *Dipha aphidivora* (Lepidoptera: Pyralidae) adult, 1 b: *Dipha aphidivora* larva (0.2-1.0 cm), 1 c: *Dipha aphidivora* larva feeding on SWA, 2 a: *Micromus* sp. (Neuroptera: Hemorabiidae) adult, 2 b: *Micromus* sp. larva, 2 c: *Micromus* sp. larvae feeding on SWA, 3 a: *Eupeodes* sp. (Diptera: Syrphidae) larva, 3 b: *Eupeodes* sp. larva feeding on SWA, 3 c: *Eupeodes* sp. Cocoons, 4: *Micraspis discolour* (Coleoptera: Coccinellidae), 5: *Synonycha* sp. (Coleoptera: Coccinellidae) adult (1.2-1.5 cm), 6: *Micraspis allardi* (Coleoptera: Coccinellidae)

Population dynamics of natural predators of SWA

According to the results, *Dipha aphidivora* and *Micromus* sp. were the prominent natural predators in Kahataruppa in Passara area. The highest population of *Dipha aphidivora* and *Micromus* sp. was recorded in the third week of April and the third week of January 2011 respectively. The syrphid predator, *Eupeodes* sp. showed an uneven distribution pattern throughout the study period (Fig. 1). These three predators were not present from third week of August to third week of December. The population density of SWA was low from August to November and started to increase their population from early December during the study period. It may be the reason for the absence of these predators during this period.

The surveys conducted in China from 1974 to 1984 indicated that *Dipha aphidivora* was one

of the most abundant and important woolly aphid suppressing factors (Cheng *et al.*, 1999). Tripathi (1995) reported that *Dipha aphidivora* as one of the most effective predators of *Ceratovacuna lanigera*. A one-year field experiment in Uttar Pradesh, India indicated that the occurrence of natural predators of SWA was not in any sequential patterns and mostly overlapped with one another. It has also been reported that the pyralid; *Dipha aphidivora* was the most dominant species in terms of density (Tripathi *et al.*, 2008). A survey for composition and abundance of biological control agents in Karnataka, India, in 2003, was conducted and found that the syrphids and hemerobiids were effective predators in isolated places adjoining forest eco systems (Lingappa *et al.*, 2004). In the observations in Kahataruppa in Passara area, the colonies of SWA were found to be suppressed by an array of these three (3) predatory insects belong to order Lepidoptera, Neuroptera, Diptera.

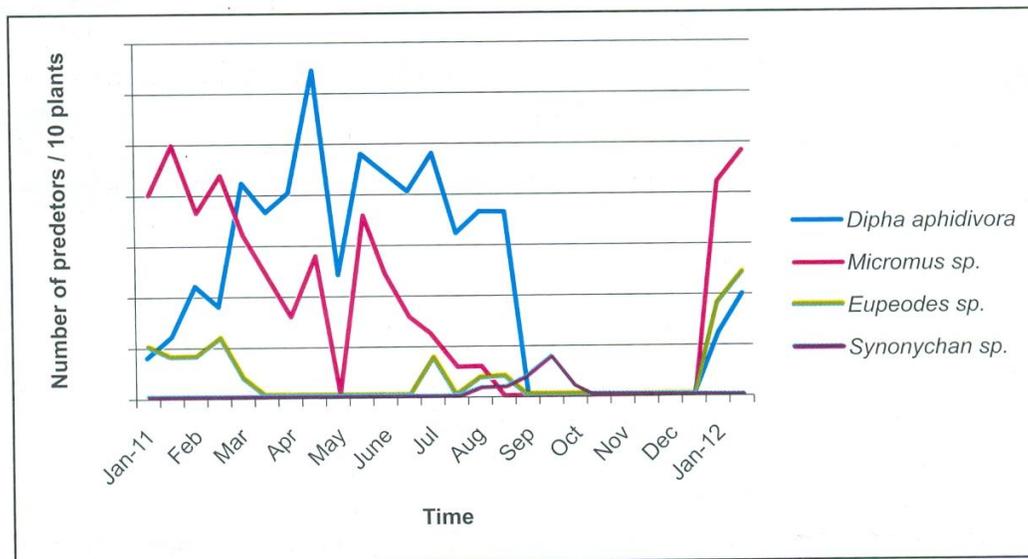


Fig. 1 - Variation of population levels of four predators of SWA from January 2011 to January 2012 at fortnightly intervals in sugarcane fields at Kahataruppa in Passara

The coccinellid predator, *Synonycha* sp. recorded only from first week of August to first week of October 2011 and relative abundance was two (2). It is low relatively to the *Dipha aphidivora* and *Micromus* sp.

Joshi and Viraktamath (2004) reported that the *Synonycha grandis* as a natural enemy of SWA in Philippines, China, Japan, Taiwan and Indo-China. In India some attempts were taken to use *Synonycha grandis* as a potential biological control agent to control SWA in Project Directorate of Biological Control (Rabindra *et al.*, 2002). In Sri Lanka the *Synonycha grandis* also reported as a natural predator of vegetable insect pests of mid country (Mayadunnage *et al.*, 2007). The coccinellid predators of SWA found in the study area occurred in low densities throughout the observational period. Further studies are in progress to explore the capability of using these predators as potential biological control agents.

CONCLUSIONS

Six different insect species from four orders including Lepidoptera, Neuroptera, Diptera and Coleoptera were identified as natural predators of the Sugarcane Woolly Aphid (SWA) (*Ceratovacuna lanigera* Zehntner, Homoptera: Aphididae) in Passara area of Badulla district. They were *Dipha aphidivora* (Lepidoptera: Pyralidae), *Micromus* sp. (Neuroptera: Hemorabiidae), *Eupeodes* sp. (Diptera: Syrphidae), *Micraspis discolor* (Coleoptera: Coccinellidae), *Micraspis allardi* (Coleoptera: Coccinellidae) and *Synonycha* sp. (Coleoptera: Coccinellidae). *Eupeodes* sp. and *Synonycha* sp. were found as the natural predators of SWA confined to Passara area. Out of all species collected *Dipha aphidivora*

and *Micromus* sp. showed high relative abundance.

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