Studies on natural enemies of Pink pineapple mealybug, *Dysmicoccus brevipes* (Cockerell) (Hemiptera: Pseudococcidae) in Kerala

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ABSTRACT: Purposive survey was conducted to document the natural enemies associated with *Dysmicoccus brevipes* in pineapple growing areas of Kerala. The survey was carried out between January to May 2016 at monthly intervals. Infested fruits were collected from pineapple fields and observed for natural enemies. The natural enemies recorded included four predators [*Spalgis epeus* (Westwood), *Cacoxenus perspicax* (Knab) and two species of *Scymnus* which are yet to be identified], one parasitoid (*Chartocerus* sp.) and the fungus *Aspergillus* sp.

INTRODUCTION

Pink pineapple mealybug, *Dysmicoccus brevipes* is reported as serious pest of pineapple in (KAU, 2002). It is also found infesting various crops viz., the roots and basal stem region of pepper (Devasahayam et al., 2009), rhizome of white ginger flower, *Hedychium coronarium* Koenig (Hernandez and Martinez, 2012) on Areca nut (*Areca catechu* L.) (Basavaraju et al., 2013). Apart from direct damage, it also causes indirect damage by transmitting two types of viruses namely Pineapple Mealybug Wilt associated virus-1 [PMWaV-1] and Pineapple Mealybug Wilt associated virus-2 [PMWaV-2] (Sether et al., 2001). Infested plants show the symptoms of yellowing of leaves, stunting, wilting and rotting of roots followed by reduced yield and low plant population (Bua et al., 2013). Mealybugs are difficult to get controlled with chemicals since they are covered with wax coating. Management of mealybugs using of synthetic insecticides results in residual toxicity in fruits and may cause human health hazards. Therefore, adopting biological control measures is more appropriate. The objective of the present study is to identify the natural enemies associated with *D. Brevipes* in pineapple plantation.

MATERIALS AND METHODS

Selection of areas for the collection of natural enemies

Purposive survey was carried out in major pineapple growing districts of Kerala viz., Ernakulam, Idukki and Thrissur. Among these districts, different locations were selected for the survey, depending on the extent of pineapple cultivation (Table 1) and GPS co-ordinates of the selected location were recorded. The survey was carried out at monthly intervals from January to May, 2016. Two infested fruits as well as plants along with the mealybugs were collected from the farmer’s fields and observed for the presence of natural enemies like predators, parasitoids and diseased insect.

Table 1. Locations selected for conducting survey

| Districts | Locations                          |
|-----------|------------------------------------|
| Ernakulam | Kaloor, Kalloorkkad, Vazhakulam, Nadukkara, Peramangalam |
| Idukki    | Kumaramangalam, Thodupuzha         |
| Thrissur  | Vellanikkara, Kootala, Poomala     |

Collection of natural enemies

Infested pineapple fruits and roots collected from the surveyed localities were examined for the presence of predators. The immature stages of predators were collected and reared to the adult stage. After the emergence of the adults, they were separated from polythene cover and preserved in alcohol (70%) and got identified. The predators got identified at the Department of Agricultural Entomology, College of Horticulture, Kerala Agricultural University,
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Thrissur. Similar procedure was followed for the parasitoids also. After its emergence from parasitized mealybugs, the parasitoids collected were preserved in alcohol (70%). The preserved specimens were got identified from Aligarh Muslim University, Uttar Pradesh, India.

**Identification of ant species associated with the *Dysmicoccus brevipes***

Ants were found associated with the mealybugs in pineapple fields under natural conditions. The ants were collected from the field and preserved in alcohol (70%). Specimens were got identified from St. Xavier’s College, Aluva.

**Isolation of entomopathogenic fungus of *Dysmicoccus brevipes***

Mealybug samples from infested fruits collected from pineapple fields were observed for the presence of dead mealybugs. The mycosed mealybug specimens were removed using a fine camel hairbrush and surface sterilized with sodium hypochlorite (1%) solution for one minute and then washed three times with sterile distilled water. Then it was transferred aseptically to Petri dishes lined with moist filter paper and incubated at room temperature of (29±1°C) for two days to observe for mycelial growth, if any. Once the fungal growth was visible externally, the specimens were carefully picked up with needle and kept in Petri dish of 8.5 cm diameter containing Potato Dextrose Agar medium (PDA). The Petri dishes were incubated at room temperature and examined daily for the growth of fungal mycelia.

**Pathogenicity test***

Pathogenicity test was carried out by spraying the spore suspension prepared from the isolated fungus on the healthy mealybug.

**RESULTS AND DISCUSSION***

**Survey and documentation of natural enemies of *Dysmicoccus brevipes***

Samples collected from different locations of Ernakulam, Idukki and Thrissur consisted of four species of predators, a parasitoid and a fungus. Predators included *Cacoxenus perspicax* (Knab) (Drosophilidae: Diptera), *Spalgis epeus* (Westwood) (Lycaenidae: Lepidoptera), two species of *Scymnus* (Coccinellidae: Coleoptera), parasitoid, *Chartocerus* sp. (Signiphoridae: Hymenoptera) and the fungus *Apergillus* sp. (Table 2).

**Table 2. Presence of natural enemies in selected locations of Ernakulam, Idukki and Thrissur districts in Kerala**

| Districts | Location | GPS Co-ordinates | Natural enemies |
|-----------|----------|-----------------|----------------|
|           |          |                 | January 2016 | February 2016 | March 2016 | April 2016 | May 2016 |
| Ernakulam | Kaloor   | 9°59’49.524”N 76°18’10.134”E | Sc, - - | Sc - - | Sc - - | Sc - - | Sc - - |
|           | Kalloorkad | 9°58’11.744”N 76°40’18.743”E | Sc, Sp | As | Sc, Sp - | Sc - - | Sc, Sp - |
|           | Peramangalam | 10°34’24.848”N 76°10’10.844”E | - - - - | - - | - - - - | - - - - | - - - - |
|           | Nadukkara | 9°56’26.056”N 76°36’54.997”E | Sc - | - | Sc - - | Sc, C | - | Sc - |
|           | Vazhakulam | 9°56’49.049”N 76°36’9.241”E | - | - | Sc - - | Sc - | Sc - | - |
| Idukki    | Kumaramangalam | 9°56’30.887”N 76°42’58.810”E | - - - - - | - - | - - - - | - - - - | - - - - |
|           | Thodupuzha | 9°53’34.728”N 76°43’19.589”E | Sc - | - | Sc - - | Sc, Sp | - | Sc, C |
| Thrissur  | Kootala  | 18°27’38.290”N 73°54’50.119”E | - - - - | - - - | - - - - | - - - - | - - - - |
|           | Poomala  | 10°36’34.438”N 76°14’2.558”E | - | - | - | - - | - - | - - |
|           | Vellanikkara (PRS) | 10°32’42.770”N 76°16’26.324”E | Sc, Sp, C | Ch | As | Sc, Sp, C | - | As | Sc, C |

Pr-Predator, Pa-parasitoids, F-Fungus, Sc-Scymnus sp., Sp- Spalgis epeus, C- Cacoxenus perspicax, Ch- Chartocerus sp., A- Apergillus sp.

GPS- Global Positioning System
Relative abundance of the natural enemies in different locations

Among different natural enemies collected from selected locations of Ernakulam, Idukki and Thrissur districts, Scymnus sp. was found to be the most abundant in all the six locations and it accounted for 68.75 per cent of the total natural enemies reported from all the locations (Table 3). It was followed by Spalgis epeus, which was reported in larger numbers only from three locations viz., Kalloorkkad, Thodupuzha and Vellanikkara with the occurrence of 37.5, 28.12 and 18.42 per cent, respectively. Similarly, Cacoxenus perspicax was also collected from three locations which includes Nadukkara (10%), Thodupuzha (9.37%) and Vellanikkara (21.05%). During the survey while, few numbers of parasitoid, Chartocerus sp. was observed and was reported from only in Vazhakulam and Vellanikkara.

Aspergillus sp. infection was noticed on D. brevipes in Kalloorkkad and Vellanikkara. It appeared to be a chance infection. However, under laboratory condition the isolated Aspergillus sp. failed to cause infection when sprayed the same on the mealybugs.

Ants associated with Dysmicoccus brevipes

Two species of ants, Camponotus mitis (Smith) (Formicidae: Formicinae) and Technomyrmex albipes (Smith) (Formicidae: Dolichoderinae) were found associated with D. brevipes in the pineapple fields (Plate 13). These ants were collected from the mealybug infested pineapple plants of Nadukkara (Ernakulam district) and found tending the mealy bugs below the ground.

Survey and documentation of natural enemies of Dysmicoccus brevipes

Among the total number of natural enemies collected from different locations of Ernakulam, Idukki and Thrissur district during January to May 2016, Scymnus sp. was the most abundant predator with 68.75 per cent relative abundance in all the locations (Table 3). Avre et al. (2011) observed that the increase in the population of Scymnus coccivora was proportional to the incidence of Phenococcus solenopsis infesting on hibiscus plant commencing first fortnight of October (0.36 per 25 plants) and attaining the maximum during second fortnight of November (1.12/25 plants).

Incidence of Spalgis epeus was first recorded in D. brevipes and it accounted for about 17.61 per cent of the total insect natural enemies collected from all the locations. Thangamalar et al. (2010) observed large number of S. epeus in the mulberry ecosystem infested by Paracoccus marginatus especially between June to October when other natural enemies were absent, while declined during October and November, when the presence of other natural enemies like Cryptolaemus montrouzieri Mulsant and Scymnus sp. were abundant. This finding supports the reason for low population of S. epeus admist high population of Scymnus sp. Cham et al. (2013) also reported high number of S. epeus in the papaya plantation infested with P. marginatus accounting for an average of 35 larvae between September 2010 to March 2011, whereas 80 per cent of S. epeus was collected during January and February. The minimum occurrence of S. epeus during the earlier months was due to the low incidence of mealybugs, D. brevipes.

Table 3. Relative abundance of predators and parasitoid of Dysmicoccus brevipes in selected locations of Ernakulam, Idukki and Thrissur districts

| Location     | Number of natural enemies | Number of predators | Number of parasitoid | Relative abundance of predators | Relative abundance of parasitoid |
|--------------|---------------------------|---------------------|---------------------|---------------------------------|---------------------------------|
|              |                           | Scymnus sp.         | Spalgis epeus       | Cacoxenus perspicax             | Chartocerus sp. |
| Kaloor       | 26                        | 26                  | -                   | -                              | -                              |
| Kalloorkkad  | 40                        | 25                  | 15                  | -                              | 62.5                           |
| Nadukkara    | 20                        | 18                  | -                   | 2                              | 90                             |
| Vazhakulam   | 20                        | 14                  | -                   | -                              | 6                              |
| Thodupuzha   | 32                        | 20                  | 9                   | 3                              | 62.5                           |
| Vellanikkara | 38                        | 18                  | 7                   | 8                              | 5                              |
| Total        | 176                       | 121                 | 31                  | 13                             | 11                             |

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The drosophilid predator, *Cacoxenus perspicax*, accounted for 7.39 per cent of the total insect natural enemies collected from few places viz., Nadukkara, Thodupuzha and Vellanikkara. Goolsby *et al.* (2002) also collected *C. perspicax* on the *Maconellicoccus hirsutus* from different location in Australia and found to be density dependent. Similarly, Sundararaj (2008) collected few numbers of *C. perspicax* from spherical mealybug, *Nipaecoccus viridis* infesting sandalwood.

*Chartocerus* sp., was also recorded (6.25%) from Vazhakulam and Vellanikkara. Beltra *et al.* (2012) recorded sporadic occurrence of about 0.9 per cent of *Chartocerus* sp. of the total number of parasitoid collected.

During the survey, two ant species viz., *Camponotus mitis* and *Technomyrmex albipes* were found symbiotically associated with *D. brevipes*. Similar association by *C. compressus* in arecanut plant infested with *D. brevipes* (Basavaraju *et al.*, 2013) and *Paracoccus marginatus* with *C. compressus* and *T. albipes* (Gowda *et al.*, 2013) were reported.

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