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Species Diversity of Leafhoppers in Major Mango Growing Regions of Karnataka

Rajkumar M.[1,2], Pramod Katti[1], Prabhuraj A.[1], Kotikal Y.K.[3], Ashoka J.[1], Ravindra Mulge[2] and Beladhadi R.V.[1]

[1]University of Agricultural Sciences, Raichur, Karnataka
[2]College of Horticulture, Bidar, UHS, Bagalkote, Karnataka
[3]University of Horticultural Sciences, Bagalkote
*Corresponding Author E-mail: rajkumar.may2007@gmail.com
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ABSTRACT

The leafhoppers alone can cause 20-100 per cent inflorescence loss in mango during vegetative and reproductive phases of the tree. They have different species composition across the mango growing area. The survey conducted across the different location of the mango growing in Karnataka during 2015-14. The result showed that the leafhoppers diversity by Shannon diversity index documented that the Brahmavara (0.61), Bidar (0.60) and Shivamogga (0.56), in contrary least was observed in Gadag (0.35), Kolar (0.39) and Dharwad (0.41) district of the Karnataka. The dominance of the leafhoppers by Simpson index recorded that highest was in Brhamavara and Bidar i.e 0.32 each and lowest dominance was in Gadag (0.16), Kolar (0.19) and Dharwad (0.20). The richness by Margalef's index displayed highest was in Belagavi (0.59) and Shivamogga districts (0.56), and least was observed in other districts ranged from 0.36 to 0.41. The abundance of the different leafhoppers species across the Karnataka revealed that the Idioscopus nitidulus (89%) was commonly prevailing and observed in all the locations followed by Amritodus atkinsoni (9%). Based on the maximum availability, the ranking was made as follow; Idioscopus nitidulus>Amritodus atkinsoni>Idioscopus nagpuriensis>Idioscopus clypealis.

Keywords: *Mango leafhoppers, Species diversity, Shannon diversity, Simpson index, Margalef's index.*

INTRODUCTION

In India, mango is considered as a major fruit crop conquering an area of about 2.18 million hectares with a production of 22.58 million metric tonnes and productivity of 7.50 MT/ha (Anonymous, 2018). To this crop nearly 250 insect and mite pests of different stages been attacked.

Among all the recorded pests, mango hoppers (*Amritodus atkinsoni* Leth, and *Idioscopus* sp.), stem borer (*Batocera rufomaculata* Deg.), mango stone weevil (*Sternochaetus mangiferae* Fab.), fruit fly (*Bactrocera dorsalis* Hendal), leaf webber (*Orthaga exvinacea* Saund.), defoliator (*Penicillaria jocosatrix* Guenee), blossom webber (*Eublemma versicolor* Walk.), leaf gall fly (*Procontarinia matteiana* Keiffer) and Cocconi tribe individuals causes significant damage to mango tree (Pena & Mohyuddin, 1997). The pest complex on mango increased to 492 species (Tandon & Verghese, 1985) and among the pests the leafhoppers are more economically important (Gangolly et al., 1957).

There are 37 different species of Auchenorrhyncha under the seven families are recorded on the mango crop all over the globe and considered as a major pest taxa of mango in India. Among the seven family, six subfamilies of 26 species from Cicadellidae family were reported to feed on mango leaves and inflorescence. Peculiarly, the subfamily Idiocerinae is a principal group of leafhoppers on mango (Viraktamath, 1989). The mango crop is mainly infested by hoppers like *A. atkinsoni*, *A. brevistylus, I. nagpurensis*, *I. nitidulus, Amrasca splendens* and *I. clypealis* in India (Dalvi et al., 1992; Viraktamath et al., 1994; & Bana et al., 2018). With the intention to develop appropriate management techniques, it is a basic requisite to have thorough knowledge of the species diversity and insects which infest on the mango area. Hence, the present experiment endeavours to discuss on the species diversity of the leafhopper in Karnataka.

MATERIALS AND METHODS

To survey to observe the species diversity of mango hoppers in Karnataka conducted at eight places representing varying agro-climatic regions were selected *viz.,* Dharwad, Belagavi, Raichur (UAS campus) (North-Western and Eastern Dry Region), Gadag (Hulkoti) (North Dry Region) Chintamani (UAS campus) (South Dry Region), Shivamogga (UAS campus) (Malnad Region), Bramhavar (Coastal Region) and Kolar (Eastern dry zone). Each place was visited once and the observations were taken by rowing survey method. In each location three trees/hybrids/varieties was selected.

In the current study, species richness indices like Shannon-Weiner's diversity index (Shannon & Weiner, 1963), Simpson's index (Simpson, 1949) and species richness (Margalef, 1968, 1969) were used for the diversity analysis. Shannon-Weiner's index also explains the richness and evenness of individuals within each taxon. Simpson's index (D) also measures the dominance or rareness of any species in the ecosystem.

Species richness

The species richness index is a very simple and direct measure of diversity, which counts the number of species collected or available in any given locality. Most qualitative data can be examined by counting the number of species and hence this measure was used under such situations.

Margalef's Index (D_{Mg})

This index is a measure of diversity used to analyse the species richness in any ecosystem. The formula for calculating this index is displayed below.

$$D_{Mg} = S\text{-}1 / \log_e N$$

Where,
S = the number of species
N = the total number of individuals

The D_{Mg} value can be anything. In this index, '0' depicts the richness is too low and if the value is increasing means richness is high.

Diversity indices:

Two important diversity indices are Shannon-Weiner index (Shannon's index for simplicity) and Simpson index were worked out for calculating the diversity of the leaf hopper species collected during the survey (Magurran, 1988).

Shannon's index, H' was computed as

$$H' = -\sum P_i \ln P_i$$

Where,

P_i = Proportion of individuals in the ith species and is given by $P_i = n_i/N$ where n_i = number of individuals of the ith species collected at the site and N is the total number of individuals of all species collected at that locality.

$\ln P_i$ = the natural log of Pi

The 'H' values can be range from "0 to 5", even though they naturally range from "1.5 to 3.5".
The assumption of the Shannon-Weiner Index is the sample for the site was collected randomly.

Simpson index was computed as

$$D = \sum \frac{n_i(n_i-1)}{N(N-1)}$$

n_i = number of individuals in the ith species

N = Total number of individuals

Values of D range from 0 to 1; increase in D value display a decline in species diversity, means greater the value, greater will be the diversity. Therefore reciprocal form of Simpson's index (1/D) is adopted in the present study and the same was used as the index of diversity.

RESULTS AND DISCUSSION

The diversity, dominance, richness and evenness of the leafhoppers on different mango varieties across the Karnataka were conducted based on the data obtained from the survey conducted during the 2015-17 (Table 1).

Shannon diversity index which tells about richness and evenness of leafhoppers was found to be very low across all the districts of Karnataka. Among all the districts, Brahmavara, Bidar and Shivamogga recorded highest diversity value *i.e* 0.61, 0.60 and 0.56, respectively. The lowest diversity was recorded in Gadag (0.35), Kolar (0.39) and Dharwad (0.41) district of the Karnataka (Table 1).

The Simpson index which tells about the dominance of the leafhopper species and it revealed that the highest dominance were recorded in Brhamavara and Bidar *i.e* 0.32 each and lowest dominance was recorded in the districts like Gadag (0.16), Kolar (0.19) and Dharwad (0.20). The richness of the species in different place based on the Margalef's index revealed that the highest was in Belagavi and Shivamogga districts *i.e* 0.59 and 0.56, respectively and all the other

districts recorded lowest species richness which was in the range from 0.36 to 0.41 (Table 1).

The study was conducted to explain the prominent species distributed among different leafhoppers species *viz., Idioscopus nitidulus, Amritodus atkinsoni, Idioscopus nagpuriensis* and *Idioscopus clypealis* in the various location of Karnataka. The result displayed that the species *Idioscopus nitidulus* (89%) was more dominant and located in all the districts of Karnataka and followed by *Amritodus atkinsoni* (9%) (Fig.1). The ranking of the leafhoppers based on their abundance, listed as follows, *Idioscopus nitidulus>Amritodus atkinsoni>Idioscopus nagpuriensis>Idioscopus clypealis* (Fig. 2). Similarly, the occurrence of *A. atkinsoni, I. nitidulus, I. clypealis* and *I. nagpuriensis* were observed all over India (Gangolly et al., 1957; & Chakrabarthi, 2014). Among them *I. nitidulus* was the most dominant (40.71%) followed by, *A. atkinsoni* (30.38%), *I. nagpurensis* (23.06) and least was *I. clypealis* (1.73%). The population distribution and variation of all the five leafhoppers were altered from place to place (Dalvi et al., 1992). It has concluded that the occurrence of the

Idioscopus nitidulus was more in different compared remaining species.
mango growing location of Karnataka

Table 1: Different diversity indices of leafhoppers collected across different regions of Karnataka

Zone	Shannon diversity Index	Simpson Index (D)	Margalef's Index (DMg)
Dharwad	0.41	0.2	0.38
Belgavi	0.49	0.24	0.59
Raichur	0.47	0.23	0.37
Gadag	0.35	0.16	0.36
Chintamani	0.49	0.25	0.39
Shivamogga	0.56	0.26	0.56
Bramhavar	0.61	0.32	0.41
Kolar	0.39	0.19	0.37
Bidar	0.6	0.32	0.36
Overall	0.5	0.24	0.4
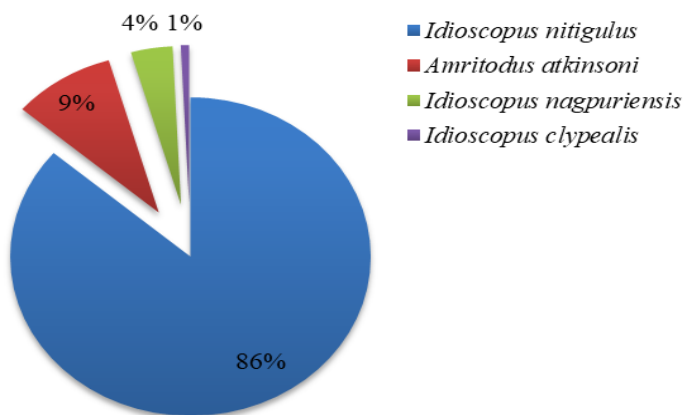
Density of different hopper species

Fig. 1: Density of different leafhopper species collected from different location of Karnataka
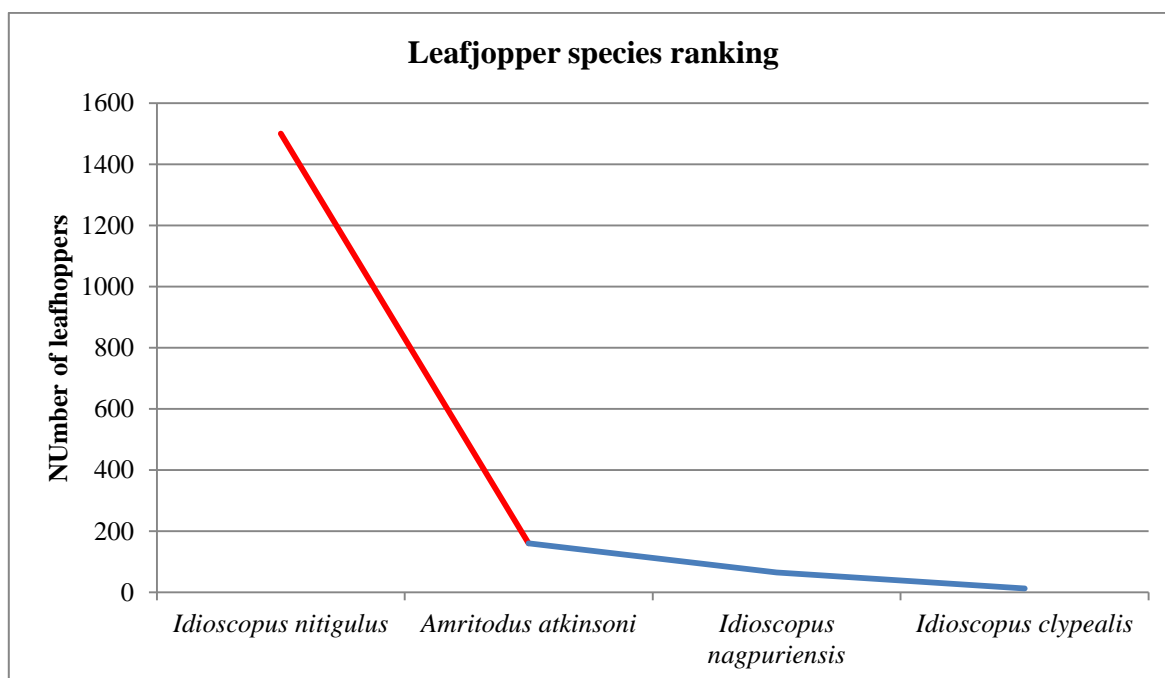
Fig. 2: Ranking of different leafhopper species collected from different location of Karnataka

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