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Abundance of Mesofauna in Guava *Psidium guajava* L. Ecosystem

NGUYEN THI KIM THOA AND N. G. KUMAR
Department of Agricultural Entomology, College of Agriculture, UAS, GKVK, Bengaluru-560 065
E-mail : ngkumar55@yahoo.co.in

ABSTRACT

The investigations on abundance of mesofauna in guava *Psidium guajava* L. ecosystem was carried out at Gandhi Krishi Vignana Kendra, University of Agricultural Scienses, Bengaluru. The samples (litter and soil) were collected from guava ecosystem from October, 2015 to September, 2016. The results indicated that litter samples harboured significantly higher abundance of mesofauna than soil samples and dominated by other invertebrates (11.53 / 100 g). The population in litter samples was significantly higher at June IIF (second fortnight) (20.27 / 100 g). Higher abundance other Acari (8.26 / 400 g) was recorded in soil samples. The population of mesofauna was significantly higher at July IF (first fortnight) (15.47 / 400 g) in soil samples. Higher total fauna abundance was recorded in litter sample (33.76 / 100 g) which was par on with soil sample (23.27 / 400 g).

Keywords : Mesofauna, ecosysyem, invertebrates, population

THE surface layer of soil is constantly receiving additions of organic matter, either as leaves or other debris of vegetation covering the ground, together with the droppings of animals or dung and other animal and vegetable residues supplied as manure to cultivated land. Soil fauna in general occupy an important position in the soil ecosystem and play a significant role in the complex process of organic matter decomposition, nutrient cycling and to improve the fertility status. The soil invertebrates play a crucial role in the terrestrial ecosystem as they control the rates of turnover and mineralization of organic substrate and accelerate the flow of energy and cycling of nutrient in soil (Reddy *et.al.,* 1994). In soil, most nutrients available for plant growth depend on complex interactions between plant roots, microorganisms and soil fauna (Bonkowski *et al*., 2000). Soil organisms contribute to a wide range of ecosystem services that are essential to the functioning of natural and managed ecosystems (Barrios, 2007). The soil ecosystem contains many less studied but often abundant groups of mesofauna, such as soil mites and other microarthropods (Coleman and Whitman, 2005). The present study was carried out to document the abundance of litter and soil mesofauna in guava (*Psidium guajava* L.) ecosystem.

MATERIAL AND METHODS

The investigations on the abundance of mesofauna in Guava (*Psidium guajava* L.) ecosystem were carried out at Division of Horticulture, Gandhi Krishi Vignana Kendra campus of the University of Agricultural Sciences, Bengaluru from October 2015 to September 2016. The experimental site is located at 13^0 05" North latitude and 77^0 35" East longitude. The soil belongs to Vijayapur series and is classified as Oxic Haplustalf. According to FAO classification, the soil is Ferric Luvisols. Soil is reddish brown, lateritic derived from granite gneiss under sub-tropical semi arid climate. Mean monthly values of different weather parameters at experimental location over the last 10 years (2006 - 2016) are 872.1 mm rainfall, 44 rainy days, 29.4 ^{0}C maximum temperature, 18.1 ^{0}C minimum temperature, 4.8 mm evaporation, 6.8 hours of sunshine hours with 90 and 47 per cent of maximum and minimum relative humidity, respectively.The guava ecosystem was established in the year 1977. The plants were planted at a distance of 7 m. Dry leaves were used as mulching material. Weeds were usually removed by shallow cultivation. Green manuring has been usually during the rainy season.

Sampling method : The samples were collected from litter and soil at fortnightly interval using the circular core sampler measuring 12 cm diameter and 10 cm height. The core sampler was placed on the soil surface and pressed downwards and turned in clockwise direction to a depth of 10 cm. The quantity of litter and soil sample collected was 100 and 400 g, respectively. Such collected samples were immediately transferred to aluminum cans (15 cm height and 6 cm diameter) and labels were placed into each can and closed with lid.

Extraction of mesofauna : The mesofauna was extracted from the soil and litter samples using Rothamsted modified McFadyen high gradient funnel apparatus in the soil biology laboratory. Soil samples were placed carefully along with the labels in canisters. The electric bulbs (25 W) fixed at the top in the baffle board served as the source of light and heat energy. The apparatus was allowed to run for 48 hours. The invertebrates including earthworms passing through 2×2 mm sieve of the sample holder were collected in vials containing 70 per cent ethyl alcohol fixed to the lower end of the funnel. These vials were periodically checked to keep the alcohol at desired levels. Labels were kept intact both in soil sample and fauna extracted vial.

Sorting procedure and preservation of mesofauna : A stereo binocular microscope (35 x magnifi-cation) was used for sorting the extracted soil invertebrates. They were separated into different taxonomic groups. The number in each group was recorded. Taxonomic groups encountered during the study period at fortnightly intervals were preserved in vials containing 75 per cent ethyl alcohol and labeled (date of collection, treatment etc.,) for further taxonomic identification.

Estimation of soil moisture : Measurement of soil moisture was made on soil samples of known weight. Soil sample was collected in airtight aluminum moisture can in each plot from desired depth. Fresh weight was recorded using electronic balance. Then it was dried in a hot air oven at 70 ^{0}C for 48 hours in the laboratory. Dry weight of the soil samples was recorded. The moisture content in percentage was calculated using the following formula.

$$\text{Moisture content (\%)} = \frac{\text{Fresh weight - Dry weight} \times 100}{\text{Dry weight}}$$

Estimation of soil temperature : Soil temperature was recorded by inserting a soil thermometer into the soil to a depth of 10 cm at the time of each sampling in each plot.

Data transformation : The data were transformed using $\sqrt{X + 0.5}$ transformations, wherever necessary and statistically analyzed by adopting analysis of variance (Sundararaj *et al.,* 1972). SPSS 16 package was used for analyzing the data.

Abundance : The total number of individuals of all arthropods species, which appeared in each treatment at the time of observation, was recorded. The data were transformed using $\sqrt{X + 0.5}$ transformations before statistical analysis (Sundararaj *et al*., 1972).

Results and Discussion

Abundance of mesofauna in Guava litter sample

In the present study, significantly higher abundance of other invertebrates (11.53 / 100 g) was recorded in guava litter ecosystem. This was followed by other Acari (9.36 / 100 g). Collembola (5.12 / 100g), Cryptostigmata (4.29 / 100 g) and Mesostigmata (3.45 / 100 g) population was on par with each other (Table I). Significant difference in abundance of soil mesofauna in Guava litter samples was observed among the intervals. The population was significantly higher at June IIF (Second fortnight) (20.27) and was on par with October IF (16.33) and August IF (12.87). However, latter two samples exhibited no difference with the population ofJune IF (10.93), July IF (10.73), September IF (10.07), August IIF (9.80) and January IIF (9.47). Significantly least population was recorded in April IF (0.80) and found no difference in population from February IF to May IIF (Table I). There was significant difference among the mesofauna at peak activity stage (June IIF). Other Acari population was higher followed by Cryptostigmata, Collembola, Other invertebrates and Mesostigmata. No activity of Cryptostigmata, Mesostigmata and Collembola was observed at least activity stage (April IF). However, other Acari was dominated followed by other invertebrates.

Abundance of mesofauna in Guava soil sample

Significant differences in the abundance of mesofauna was noticed. Other Acari (8.26 / 400 g) was dominated and no difference in population of Collembola (5.47 / 400 g) and other invertebrates (5.27 / 400 g) was observed. Cryptostigmata (2.45 / 400 g) and Mesostigmata (1.82 / 400 g) population was on par with each other (Table II). Significant difference in abundance of soil mesofauna was documented in

TABLE I

The abundance of mesofauna in guava ecosystem (litter sample)

Meso-fauna	Mesofauna (#/100g litter)										
	Oct.IF	Oct.IIF	Nov.IF	Nov.IIF	Dec.IF	Dec.IIF	Jan.IIF	Feb.IF	Feb.IIF	Mar. IF	Mar.IIF
Cryptostigmata	9.00	0.67	6.33	4.00	1.00	0.00	1.67	0.00	0.00	0.00	0.00
	(2.97)	(1.05)	(2.52)	(1.91)	(1.09)	(0.71)	(1.35)	(0.71)	(0.71)	(0.71)	(0.71)
Mesostigmata	13.33	1.67	6.00	10.00	7.00	2.00	17.33	3.67	4.67	1.00	0.00
	(3.61)	(1.35)	(2.28)	(3.06)	(2.70)	(1.48)	(3.87)	(1.85)	(2.02)	(1.09)	(0.71)
Other Acari	0.00	0.00	0.00	0.00	4.67	0.67	8.67	0.00	0.00	0.67	1.67
	(0.71)	(0.71)	(0.71)	(0.71)	(2.06)	(1.00)	(2.97)	(0.71)	(0.71)	(1.00)	(1.46)
Collembola	16.00	0.33	14.00	10.33	4.67	8.00	5.00	0.00	0.00	0.33	0.00
	(3.81)	(0.88)	(3.76)	(3.12)	(2.22)	(2.70)	(2.16)	(0.71)	(0.71)	(1.00)	(0.71)
Other invertebrates	43.33	7.67	3.00	16.67	11.33	4.33	14.67	8.00	9.00	37.00	3.33
	(6.37)	(2.83)	(1.82)	(3.97)	(3.40)	(2.14)	(3.52)	(2.92)	(2.67)	(4.55)	(1.89)
Mean	**16.33**	**2.07**	**5.87**	**8.20**	**5.73**	**3.00**	**9.47**	**2.33**	**2.73**	**7.80**	**1.00**
	(3.49)^{ab}	**(1.36)^{ef}**	**(2.21)^{de}**	**(2.55)^{cd}**	**(2.29)^{de}**	**(1.60)^{ef}**	**(2.77)^{bcd}**	**(1.38)^{ef}**	**(1.36)^{ef}**	**(1.64)^{ef}**	**(1.09)^{f}**

TABLE 1 Continued

Meso-fauna	Mesofauna (#/100g litter)											
	Apr.IF	Apr.IIF	May.IF	May.IIF	Jun..IF	Jun.IIF	Jul.IF	Aug.IF	Aug.IIF	Sep. IF	Sep.IIF	**Mean**
Cryptostigmata	0.00	0.00	0.00	1.33	6.33	24.67	5.00	14.33	9.67	10.33	0.00	**4.29**
	(0.71)	(0.71)	(0.71)	(1.26)	(2.52)	(4.89)	(2.27)	(3.68)	(3.15)	(3.10)	(0.71)	**(1.73)^{e}**
Mesostigmata	0.00	1.00	0.00	0.00	1.33	2.33	0.67	1.33	1.00	1.67	0.00	**3.45**
	(0.71)	(1.09)	(0.71)	(0.71)	(1.18)	(1.67)	(1.05)	(1.18)	(1.17)	(1.25)	(0.71)	**(1.61)^{e}**
Other Acari	2.33	3.33	4.00	5.67	35.33	46.00	25.33	25.00	24.00	16.00	2.67	**9.36**
	(1.49)	(1.88)	(2.08)	(2.36)	(5.42)	(6.78)	(4.81)	(4.90)	(4.92)	(3.53)	(1.76)	**(2.39)^{b}**
Collembola	0.00	0.67	0.00	0.00	1.33	20.33	2.00	11.00	8.67	8.67	1.33	**5.12**
	(0.71)	(1.00)	(0.71)	(0.71)	(1.29)	(4.30)	(1.55)	(3.34)	(2.68)	(2.32)	(1.29)	**(1.89)^{e}**
Other invertebrates	1.67	2.67	8.67	4.00	10.33	8.00	20.67	12.67	5.67	13.67	7.33	**11.53**
	(1.46)	(1.61)	(2.83)	(2.08)	(3.14)	(2.76)	(4.43)	(3.54)	(2.35)	(3.46)	(2.58)	**(3.01)^{a}**
Mean	**0.80**	**1.53**	**2.53**	**2.20**	**10.93**	**20.27**	**10.73**	**12.87**	**9.80**	**10.07**	**2.27**	
	(1.01)^{f}	**(1.27)^{f}**	**(1.40)^{ef}**	**(1.42)^{ef}**	**(2.71)^{bcd}**	**(4.08)^{a}**	**(2.82)^{bcd}**	**(3.33)^{abc}**	**(2.85)^{bcd}**	**(2.73)^{bcd}**	**(1.41)^{ef}**	
										CV%	SEm ±	CD@5%
Treatment										51.71	0.13	0.25
Duration											0.28	0.55
Interaction											0.63	1.24

Note: Figures in the parentheses are $\sqrt{X+0.5}$ transformed values; IF: First fortnight; IIF: Second fortnight

TABLE II

The abundance of mesofauna in guava ecosystem (soil sample)

Meso-fauna	Mesofauna (#/100g litter)										
	Oct.IF	Oct.IIF	Nov.IF	Nov.IIF	Dec.IF	Dec.IIF	Jan.IIF	Feb.IF	Feb.IIF	Mar. IF	Mar.IIF
Cryptostigmata	8.67	3.00	3.33	1.00	0.00	0.00	2.00	1.00	0.00	2.67	0.00
	(3.02)	(1.67)	(1.79)	(1.09)	(0.71)	(0.71)	(1.47)	(1.09)	(0.71)	(1.64)	(0.71)
Mesostigmata	4.33	1.67	2.00	1.00	0.00	2.00	4.00	7.33	3.33	10.00	0.67
	(2.15)	(1.46)	(1.32)	(1.17)	(0.71)	(1.32)	(1.93)	(2.05)	(1.93)	(3.17)	(1.00)
Other Acari	0.00	1.00	0.00	4.33	0.00	2.33	11.33	15.67	2.33	0.00	0.67
	(0.71)	(1.17)	(0.71)	(2.15)	(0.71)	(1.49)	(2.82)	(3.94)	(1.38)	(0.71)	(1.00)
Collembola	1.33	0.67	1.67	8.00	0.00	9.00	4.33	1.67	0.67	2.00	0.00
	(1.34)	(1.00)	(1.44)	(2.39)	(0.71)	(2.73)	(1.98)	(1.38)	(1.00)	(1.32)	(0.71)
Other invertebrates	6.00	5.00	0.33	3.00	0.00	2.00	2.33	7.67	2.33	5.33	0.67
	(2.37)	(2.27)	(0.88)	(1.87)	(0.71)	(1.42)	(1.67)	(2.80)	(1.56)	(2.40)	(1.05)
Mean	**4.07**	**2.27**	**1.47**	**3.47**	**0.00**	**3.07**	**4.80**	**6.67**	**1.73**	**4.00**	**0.40**
	(1.92)^{cdef}	**(1.51)^{cdefgh}**	**(1.22)^{efgh}**	**(1.74)^{cdefg}**	**(0.71)^{h}**	**(1.53)^{cdefgh}**	**(1.97)^{cde}**	**(2.25)^{bc}**	**(1.31)^{defgh}**	**(1.84)^{cdef}**	**(0.90)^{gh}**

TABLE II Continued

Meso-fauna	Mesofauna (#/100g litter)											
	Apr.IF	Apr.IIF	May.IF	May.IIF	Jun..IF	Jun.IIF	Jul.IF	Aug.IF	Aug.IIF	Sep. IF	Sep.IIF	**Mean**
Cryptostigmata	0.00	0.00	5.67	4.33	5.67	8.33	6.33	0.00	0.67	1.00	0.33	**2.45**
	(0.71)	(0.71)	(2.16)	(1.99)	(2.04)	(2.87)	(2.52)	(0.71)	(0.99)	(1.17)	(0.88)	**(1.44)^{b}**
Mesostigmata	0.00	0.00	0.00	0.00	0.00	1.00	2.67	0.00	0.00	0.00	0.00	**1.82**
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(1.09)	(1.73)	(0.71)	(0.71)	(0.71)	(0.71)	**(1.25)^{b}**
Other Acari	3.00	2.67	14.33	2.67	32.67	36.00	24.33	3.33	1.00	1.33	22.67	**8.26**
	(1.87)	(1.44)	(3.49)	(1.55)	(4.87)	(5.95)	(4.26)	(1.84)	(1.09)	(1.18)	(4.73)	**(2.23)^{a}**
Collembola	1.00	0.00	4.33	24.33	2.67	12.00	27.67	6.00	1.00	4.00	8.00	**5.47**
	(1.09)	(0.71)	(1.82)	(4.37)	(1.77)	(3.30)	(5.27)	(2.41)	(1.17)	(1.84)	(2.48)	**(1.92)^{a}**
Other invertebrates	7.00	7.33	6.67	3.33	23.33	6.00	16.33	4.67	1.33	2.33	3.00	**5.27**
	(2.60)	(2.68)	(2.66)	(1.93)	(4.47)	(2.28)	(3.76)	(2.06)	(1.26)	(1.64)	(1.67)	**(2.09)^{a}**
Mean	**2.20**	**2.00**	**6.20**	**6.93**	**12.87**	**12.67**	**15.47**	**2.80**	**0.80**	**1.73**	**6.80**	
	(1.39)^{cdefgh}	**(1.24)^{efgh}**	**(2.17)^{bcd}**	**(2.11)^{bcde}**	**(2.84)^{ab}**	**(3.10)^{a}**	**(3.51)^{a}**	**(1.54)^{cdefgh}**	**(1.04)^{fgh}**	**(1.30)^{defgh}**	**(2.09)^{bcde}**	
										CV (%)	SEm ±	CD@5%
Treatment											0.12	0.23
Duration										56.66	0.26	0.51
Interaction											0.59	1.16

Note: Figures in the parentheses are $\sqrt{X+0.5}$ transformed values; IF: First fortnight; IIF: Second fortnight

Guava soil sample at different intervals. The population was significantly higher at July IF (first fortnight) (15.47) and found no difference with the population of June IF (12.87) and June IIF (12.67). Significantly least population was recorded in March IIF (0.40) and absent in December IF (Table 2II). There was significant difference among the mesofauna at peak activity stage (July IF). Collembola population was higher followed by Other Acari, Other invertebrates, Cryptostigmata and Mesostigmata in Guava soil samples.

Abundance of mesofauna in Guava litter and soil

The abundance of mesofauna varied among the litter and soil samples. Litter harboured more fauna compared to soil (Fig. 1). The abundance of mesofauna was more in the month of June IIF (101.33 / 100 g of litter) followed by October IF (81.67), August IF (63.44), Jun IF (54.67) and the lowest population of

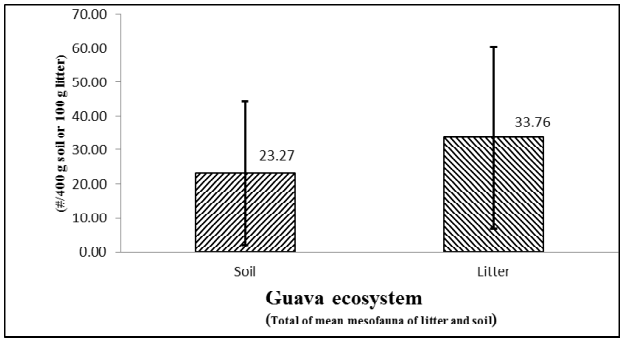

Fig.1 : Abundance of total fauna in Guava ecosystem

total fauna was observed in April IF (4.00) in litter samples. The population of total fauna was more in the month of July IF (77.33 / 400g of soil) followed by June I and IIF (64.33 and 63.33).The least population of total fauna was observed in Mar. IIF (2.00) and no activity of fauna was observed in December IF in soil samples (Fig. 2). Activity of both litter and soil mesofauna was more during rainy months (June to August month) which coincided with higher soil and litter moisture content with moderate soil temperature (Fig. 2). Similarly, the abundance of litter and soil mesofauna were lower from December to May month which coincided with higher soil temperature and lower moisture content in both litter and soil. This also due to higher atmosphere temperature,evaporation and

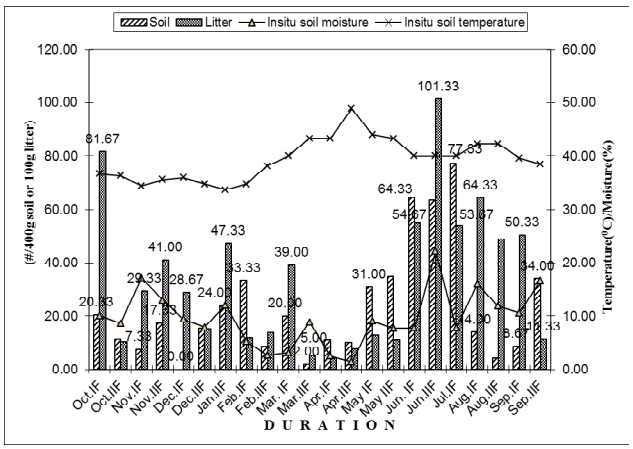

Fig. 2 : Abundance of total fauna in Guava litter and soil during October, 2015 to September, 2016

sunshine hours. Further, Cryptostigmata, Mesostigmata and Collembola were very sensitive to variation in above said weather parameter andfound no activities of these organisms during low soil moisture conditions. In support of the present investigations, Moitra (2013) collected soil samples from three different habitats at monthly intervals and documented. Order Oribatida as the highest numerically abundant group of acrarines followed by order Mesostigmata. Similarly, Postma-Blaauw *et al.* (2012) showed that in arable land the numbers, and the taxonomic diversity of mesostigmatid mites (which includes the predatory taxa) were low, while in grassland more taxa were found and in higher numbers. Rieff *et al*. (2010) and Borah and Kakati (2013) observed more soil biota abundance in natural forest or uncultivated ecosystems compared to agro ecosystem. Further, they also reported less cultivation practices helped to multiplication of soil fauna compared to short duration cropping system. However, Mahajan and Singh (1981) recorded higher collembolan populations during the monsoon months (July-September) when soil moisture was high and soil temperature was low.

The present study revealed that higher mesofaunal population activity both in litter and soil was noticed during early rainy season compared to later rainy and summer season, which may be due to variation in moisture content in soil and atmospheric temperature and light intensity in guava ecosystem.

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