Journal of Entomology and Zoology Studies 2024; 12(5): 137-141

Journal of Entomology and Zoology Studies
Available online at www.entomoljournal.com
J E Z S
Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2024; 12(5): 137-141

Received: 08-08-2024
Accepted: 10-09-2024

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Seasonal occurrence of zoo-phytophagous mirid bug, *Nesidiocoris tenuis* (Reuter) on sesame in relation to weather parameters

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DOI: https://doi.org/10.22271/j.ento.2024.v12.i5b.9390

Abstract
The investigation on seasonal occurrence of zoo-phytophagous mirid bug, *Nesidiocoris tenuis* (Reuter) on sesame in relation to weather parameters was under taken at Agriculture College Vishweswaraiah Canal Farm, Mandya during 2022-23. In *summer* 2022, the occurrence of mirid bug, *N. tenuis* varied between 0.00 to 5.60/bugs per plant with a mean of 1.86/ bugs per plant and zero population was noticed January second week. The bug population progressively decreasing from March third week (2.30/bugs per plant) and no activities was observed from April first week onwards. Likewise, in *kharif* 2022, the densities of mirid bug, *N. tenuis* was in between 0.00 to 7.30/bugs per plant, with an average population of 2.90/bugs per plant and no occurrence was noticed in August first week. The multi linear regression statistical analysis (MLR) clearly indicated 68 per cent (R^2 = 0.68) of l mirid bug, *N. tenuis* population influenced by afternoon RH positively in summer 2022. Similarly, in *kharif* 2022, 63 per cent (R^2 = 0.63) of mirid bug, *N. tenuis* densities found influencing by morning RH positively and sunshine hours negatively.

Keywords: Population dynamics, zoo-phytophagous, *Nesidiocoris tenuis,* weather parameters, sesame

Introduction
Sesame, *Sesamum indicum* (Linn.) an oldest oilseed plant cultivated in tropics and warm temperate regions (Tripathi *et al*., 2007) [17]. The sesame is popularly known as gingly, til and. The genera *Sesamum* belongs to the Pedaliaceae family with order Tubiflorae, comprising 16 genera with 60 species (Weiss, 1983) [21]. The native of sesame is debatable and it is expected to have originated from India or Africa. But due to the presence of diverse wild species in Africa, the Africa, was considered as the primary origin of sesame.

The oil seed sesame is an important crop cultivated in both tropical and subtropical area in India and rest of the world (Karuppaiah and Nadarajan, 2013) [11]. Worldwide, the sesame crop is grown in more than 7 million hectare with a production of 4 million tonnes and productivity of 535 kg/ha annually. China and India are considered as largest producers of sesame in the world's compared to Turkey, Mexico, Burma, Sudan, Nigeria, Venezuela, Ethiopia and Uganda as major sesame growers. Sesame was cultivated in India in a area of 11.75 lakh hectare with a production of 0.83 million tonnes annualy. The productivity of Sesame in India is considerable low (474kg/ha). The sesame crop is majorly grown in Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan, and West Bengal which contributes for 1.56 m ha. In Karnataka state, the sesame crop is widely cultivated in Mysore, Ramanagar Koppal, Bagalkot, Raichur, Gadag, Bidar, Haveri, Gulbarga, Dharwad and Bellary districts which accounts for 44,000 ha of area with a production of 22,000 tonnes.

The sesame is an important nutritionally rich oil seed crop but both productivity level and yields are low and it's been attributed to various factors. The yield reduction is decreasing in recent times due to several poor agronomic factors, soil fertility and health and infestation of insect pests, various diseases and weeds (Weiss, 1983; Sekabembe *et al*., 2001) [21,]. Among biotic factors, insect pest infestation, fungal and viral diseases are major ones (Ssekabembe *et al.*, 2001) [22]. The sesame crop is attacked by 29 insect species (Rai, 1976), but due to changing cultivation practices the number of insect pests on sesame has increase to 65 species including notorious white mite, (*Polyphagotarsonemus latus* Blanks).

(Ahuja and Bakhetia, 1993) [2]. The major insect pest which attacks sesame crop in India were leaf webber and capsule borer, *Antigastra catalaunalis* Duponchel (Pyraustidae: Lepidoptera), gall fly, *Asphondylia sesami* Felt (Cecidomyiidae: Diptera), leaf eating caterpillar, *Acherontia styx* Westw (Sphingidae: Lepidoptera) and aphid, *Aphis gossypii* Glover (Aphididae: Homoptera). Amongst these insect pests, a jassid vector of phyllody, *Orosius albicinctus* Distant (Cicadellidae: Homoptera) is the important sucking pest which transmit "Sesame phyllody disease" in association with phytoplasma. The nymphs and adults of leafhoppers found in all growing stage of the crop causing yield losss up to 90 per (Ahuja and Bakhetia, 1995) [3].

The zoo-phytophagous mirid bug, *Nesidiocoris tenuis* (Reuter) (Miridae: Hemiptera) one of the important naturally occurring biological control agent for several field and horticultural crops pest species namely thrips, aphids, and mites. In sesame ecosystem in India, it is found to be dominant predator on many young ones of sucking insects and mites, This species of beneficial mirid bug is considered as one of the saucerful natural biological control in many vegetables' ecosystem (Castane *et al*. 2011) [7]. In many countries in Europe, the *N. tenuis* is being suggested for the management of sucking pests in high-tech greenhouse (Calvo *et al*. 2012) [6]. Since, the Southern parts of Karnataka is major sesame producing region in the state, and the earlier studies revealed sparse information on seasonal incidence of zoo-phytophagous mirid bug, *Nesidiocoris tenuis* (Reuter) and its population dynamics with changing meteorological variables, the present investigation was undertaken during 2022-23 at Agriculture College, Vishweswaraiah Canal Farm, Mandya, Karnataka, India.

Materials and Methods

The investigations were conducted under field conditions to know the population dynamics and abundance of zoo-phytophagous mirid bug, *Nesidiocoris tenuis* in sesame ecosystem during both *summer* and *kharif* 2022. A national check and susceptible multi-capsule sesame cultivar GT- 1 was sown in three blocks with an area 12 X 15 m (180 m^2). The spacing provided was 15 X30 cm, between plants and rows. The healthy crop was maintained by adopting and following good agronomic practices without any pest management practice (Anon., 2014) [4].

In each block, randomly 20 sesame plants were tagged to observe and to collect data on the population dynamics and abundance mirid bug, *Nesidiocoris tenuis*. In each designated blocks, the data on activities and number of nymphs and adults were collected starting from 7days after germination to till harvesting of the crop. The observation on incidence of mirid bug, *Nesidiocoris tenuis* were made on 20 tagged plants on leaves, flowers and capsules. The observations obtained on abundance of mirid bug, *Nesidiocoris tenuis* were processed to obtained mean population per plant for interpretation. Likewise, the prevailing weather data *viz*., temperature (max, & min), relative humidity (morning & afternoon), and other weather factors are obtained from Automated weather station existing farm section of Agriculture College, Mandya and processing of weekly weather data was done for regression and correlation analysis.

Statistical analysis

To find out the association among weather factors and weekly dynamics of mirid bug, *Nesidiocoris* the weekly data on nymphs and adult population of mirid bug, *Nesidiocoris tenuis* and weekly meteorological observations (mean) were analysed by following Pearson's rank correlation method. Likewise, to investigate the relative effect of prevailing weather factors on population fluctuation and dynamics of mirid bug, *Nesidiocoris tenuis*, both mean data on biotic and abiotic factors subjected to "MLR Analysis Techniques (Pans and Sukhatme, 1967) [14] using statistical software "SAS Syntax Reference Guide 2024, version 24.0 (SPSS, 24).

Results and Discussion

The adults and nymphs are green in colour (Plate 1). Both nymphs and adults found feeding on adults and nymphs of sucking pest's *viz*., mealybugs, aphid, whiteflies, leaf hopper, thrips and several species of phytophagous mites. In *summer* 2022, the incidence of mirid bug, *Nesidiocoris tenuis* was varied between 0.00 to 5.60 bugs per plant with an average population of 1.86 bugs per plant and zero incidence of mirid bug, *Nesidiocoris tenuis* was noticed in January second week. However, incidence of mirid bug, *Nesidiocoris tenuis* initiated from January second week (0.30 bugs per plant) and a steady increase was observed in first week of February to first week of March with a highest number of bugs (5.60/ plant). However, bug population started decreasing slowly from March third week onwards (2.30/plant) with zero incidence from April first week onwards (Table 1).

Similarly, in *kharif* 2022, the occurrence of mirid bug, *Nesidiocoris tenuis* was in between 0.00 to 7.30 bugs per plant, with an average of 2.90 bugs per plant and no activities of mirid bug, *Nesidiocoris tenuis* was recorded in August first week. Further, the activities of bugs initiated from August second week (0.50 bugs per plant) and was a steadily more activities of bugs were noticed in from August third week to September third week with a highest incidence of 7.30 bugs per plant. Further, the activities of mirid bug, *Nesidiocoris tenuis* steadily declining in October first week (2.20/ plant) and no activities of mirid bug, *Nesidiocoris tenuis* was observed from November fourth week onwards (Table 2). The present results corroborate with the results of Ahirwar *et al.* (2008) [1] who reported peak population during second week of September.

The results of correlation coefficients between weather factors and mirid bug, *Nesidiocoris tenuis* densities showed a significant negative relationship with sunshine hours (r=-0.47). On contrary a positive relationship with mean maximum temperature (r=0.33), morning RH (r=0.06) and afternoon RH (r=0.52). However, the contributions of afternoon RH showed significant relationship (Table 3 and Figure 1). Further, the findings of stepwise regression analysis indicated a 68 per cent of the mirid bug, *Nesidiocoris tenuis* densities (R^2=0.68) found influencing by the afternoon RH positively (Table 4).

Similarly, in *kharif* 2022, The results of correlation coefficients between weather factors and mirid bug, *Nesidiocoris tenuis* densities showed a negative significant relationship with sunshine hours (r=-0.80) and positive relationship with minimum temperature (r=0.40), morning RH (r=0.50), afternoon RH (r=0.42), rainfall (r=0.36) and number of rainy days (r=0.41). Among the variables, the influence of morning RH and sunshine hours observed as significant (Table 5, Figure 2).

Further, the findings of stepwise regression analysis indicated a 63 per cent of the mirid bug, *Nesidiocoris tenuis* densities (R^2=0.63) found influencing by morning RH positively and sunshine hours negatively (Table 6). These findings are confirmed with report of Ahirwar *et al*., (2009) [1], where they found significant positive relationship in mirid bug, *Nesidiocoris tenuis* densities with minimum temperature. These changes may occur due to crop variety, crop canopy stand and location climatic factors. The result of in present study also in partial accordance with Mishra *et al.*, (2015) [13], where they observed a significant positive relation with maximum and minimum temperature. Similarly, our are contradicted by report of Sridhar *et al*. (2012), where they found a non-significant negative correlation with mirid bug, *Nesidiocoris tenuis* population and maximum temperature, afternoon RH and rainfall, this might be due to variation in the season, cropping pattern and other climatic factors.

Plate 1: Adults of zoo-phytophagous mirid bug, *Nesidiocoris tenuis*

Table 1: Population dynamics of mirid bug, *Nesidiocoris tenuis* in relation to Meteorological variables, *summer* 2022

Month	MSW	Nymphs and adults/plant	Temperature (°C)		Relative humidity (%)		Sunshine hours	Rainfall (mm)	Rainy days
			Maximum	Minimum	Morning	Afternoon			
Jan	2	0.00	29.50	11.00	75.26	33.37	6.62	0.00	0.00
	3	0.30	30.28	12.85	84.93	41.03	5.74	0.00	0.00
	4	1.30	30.28	16.14	82.76	60.25	6.73	0.00	0.00
Feb	5	1.30	29.71	14.78	91.67	63.44	7.68	0.00	0.00
	6	2.00	30.42	13.78	89.07	60.32	7.24	0.00	0.00
	7	3.60	30.71	15.28	90.79	62.64	7.42	0.00	0.00
	8	4.20	34.28	17.07	77.33	71.21	5.95	0.00	0.00
March	9	5.60	34.35	14.71	82.99	70.01	5.29	0.00	0.00
	10	3.60	35.14	14.71	79.53	76.65	4.83	0.00	0.00
	11	2.30	35.85	14.78	72.43	58.04	3.36	0.00	0.00
	12	1.40	36.71	15.35	85.77	59.76	6.90	0.00	0.00
	13	0.40	36.42	15.57	78.97	64.76	7.84	0.00	0.00
April	14	0.00	36.64	16.21	76.72	67.18	7.55	0.00	0.00
	15	0.00	36.78	17.35	85.57	67.59	7.45	0.00	0.00

MSW: Meteorological standard week

Table 2: Population dynamics of mirid bug, *Nesidiocoris tenuis* in relation to Meteorological variables, *kharif* 2022

Month	MSW	Nymphs and adults/plant	Temperature (°C)		Relative humidity (%)		Sunshine hours	Rainfall (mm)	Rainey days
			Maximum	Minimum	Morning	Afternoon			
Aug	31	0.00	29.69	20.03	89.54	64.87	3.49	4.10	0.00
	32	0.50	30.91	19.94	94.36	54.48	7.55	1.00	0.00
	33	3.40	33.08	19.64	90.70	56.39	6.20	0.00	0.00
	34	3.60	33.38	20.72	91.86	48.22	6.07	37.40	1.00
	35	5.50	33.17	21.10	93.59	60.81	1.79	65.70	2.00
Sep	36	5.40	33.40	18.85	91.06	59.40	3.09	0.00	1.00
	37	6.90	33.32	18.37	90.96	60.88	1.85	62.20	2.00
	38	7.30	33.17	20.07	92.53	62.63	1.00	0.00	0.00
	39	4.10	33.25	18.61	93.25	59.73	3.90	6.00	1.00
Oct	40	2.20	33.52	18.28	91.01	52.04	7.34	0.00	0.00
	41	1.40	33.28	19.00	89.56	61.36	4.88	65.00	2.00
	42	0.30	36.54	16.62	79.11	50.43	6.03	0.00	0.00
	43	0.00	34.71	15.20	90.50	52.98	7.87	0.00	0.00
Nov	44	0.00	33.85	18.78	77.26	52.83	8.19	0.00	1.00

MSW: Meteorological standard week

Table 3: Relationship between *N. tenius* and meteorological variables, *summer* 2022

Parameters	X_1	X_2	X_3	X_4	X_5
Y- *N. tenuis* population	0.33	0.16	0.06	0.52*	- 0.47
X_1- Maximum temperature	1.00	0.59	- 0.42	0.56	- 0.16
X_2- Minimum temperature		1.00	0.06	0.78	0.19
X_3- Morning relative humidity			1.00	0.10	0.53
X_4- Afternoon relative humidity				1.00	- 0.02
X_5- Sunshine hours					1.00

N= 14; * Significant at $p \leq 0.05$

Table 4: Stepwise regression analysis showing significant variables against *N. tenuis, summer* 2022

Parameters	Multiple regression co-efficient	Standard error	'T' Value	'F' Value	R^2 Value
Afternoon relative humidity	1.24	0.35	3.56	6.36	0.68

Table 5: Relationship between *N. tenuis* and meteorological variables, *kharif* 2022

Parameters	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y- *N. tenuis* population	0.02	0.40	0.50*	0.42	- 0.80**	0.36	0.41
X_1- Maximum temperature	1.00	- 0.62	- 0.50	- 0.52	0.19	-0.01	0.07
X_2- Minimum temperature		1.00	0.40	0.34	- 0.41	0.32	0.27
X_3- Morning relative humidity			1.00	0.38	- 0.40	0.24	0.09
X_4- Afternoon relative humidity				1.00	- 0.78	0.28	0.30
X_5- Sunshine hours					1.00	- 0.43	- 0.42
X_6- Rainfall						1.00	0.89
X_7- Rainy days							1.00

N= 14; * Significant at $p \leq 0.05$

Table 22: Stepwise regression analysis showing significant variables against *N. tenuis, kharif* 2022

Parameters	Multiple regression co - efficient	Standard error	't' value	'F' value	R^2 Value
Sunshine hours	- 7.16	0.20	4.54	20.64	0.63

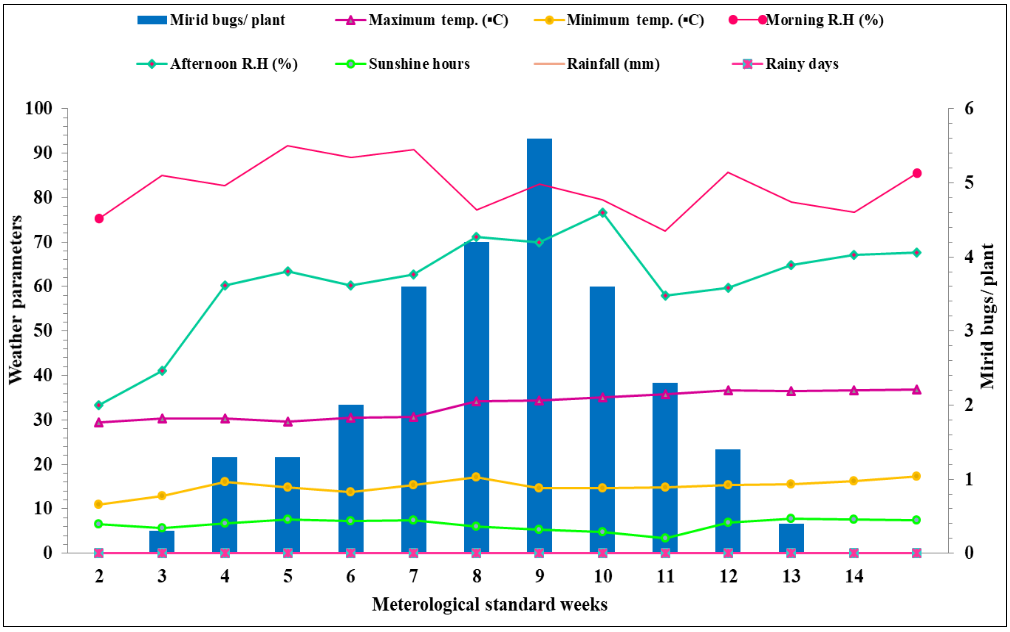

Fig 1: Influence of meteorological variables on the incidence of mirid bug, *N. tenuis, summer* 2022

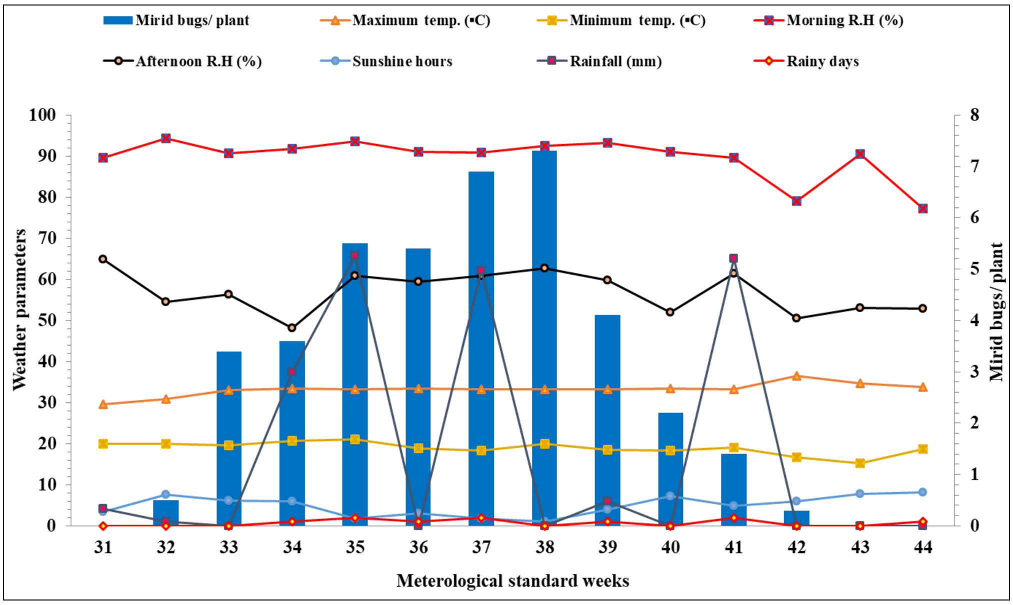

Fig 2: Influence of meteorological variables on the incidence of mirid bug, *N. tenuis, kharif* 2022

Conclusion

In *summer* 2022, the occurrence of mirid bug, *N. tenuis* varied between 0.00 to 5.60/bugs per plant with a mean of 1.86/ bugs per plant and zero population was noticed January second week. The bug population progressively decreasing from March third week (2.30/bugs per plant) and no activities was observed from April first week onwards. Likewise, in *kharif* 2022, the densities of mirid bug, *N. tenuis* was in between

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Conflict of interest
The authors declare that they have no competing interests to express.

Acknowledgements
The authors are grateful to the authorities of University of Agricultural Sciences, Bangalore. The thanks are also due to the Dean (PGS), Directorate of Post Graduate studies and Director of Research, University of Agricultural Sciences, Bangalore.

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