



Seasonal Incidence of Insect Pests and Natural Enemies in *rabi* Groundnut

M. Lokesh ^a, K. Kavitha ^{b++}, M. A. Prajwal Gowda ^{a*},
M. Rajashekhar ^{c#}, D. Akhilandeshwari ^a
and S. Ameer Basha ^{d†}

^a Department of Entomology, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, India.

^b Department of Entomology, AINP on Pesticide Residues, PJTSAU, Rajendranagar, India.

^c Department of Entomology, AINP on Vertebrate Pest Management, PJTSAU, Rajendranagar, India.

^d Department of Entomology, Agricultural College, PJTSAU, Rajendranagar, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/acri/2024/v24i9867>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here:

<https://www.sdiarticle5.com/review-history/123174>

Original Research Article

Received: 03/07/2024

Accepted: 05/09/2024

Published: 05/09/2024

ABSTRACT

The study aims to monitor the seasonal patterns of insect pests and their natural enemies in *rabi* groundnut. There were two surveys involved: fixed plot and roving survey. In fixed plot survey under sprinkler method of irrigation revealed peak incidence of insect pests viz., aphids (3.00/3

⁺⁺ Senior Scientist;

[#] Scientist;

[†] Associate Professor;

*Corresponding author: Email: prazzugowdru@gmail.com;

Cite as: Lokesh, M., K. Kavitha, M. A. Prajwal Gowda, M. Rajashekhar, D. Akhilandeshwari, and S. Ameer Basha. 2024. "Seasonal Incidence of Insect Pests and Natural Enemies in *Rabi* Groundnut". *Archives of Current Research International* 24 (9):42-56. <https://doi.org/10.9734/acri/2024/v24i9867>.

leaves/plant) during 49th MSW, thrips (3.12/3 leaves/plant), leaf hoppers (2.70/3 leaves/plant), leaf miner (2.76larvae/plant) and tobacco caterpillar (2.64larvae/plant) during 44th MSW, respectively. Whereas, the peak incidence of coccinellid beetles and spiders were noticed during 45th MSW with 1.60/plant and 1.50/plant respectively persisted upto 49th MSW (1.30/plant) and 47th MSW (1.30/plant) later their population declined. Results pertaining to insect pest and natural enemy incidence in fixed plot survey under conventional method of irrigation revealed peak population of insect pests viz., aphids (5.30/3 leaves/plant), thrips (2.40/3 leaves/plant), leaf hopper (2.60/3 leaves/plant), leaf miner with 2.50 larvae/plant and tobacco caterpillar (2.70 larvae/plant) during 44th MSW, 49th and 52nd MSW, 52nd MSW, 50th to 52nd MSW and 49th MSW, respectively. Whereas, peak incidence of grubs and adults of coccinellid beetles were recorded during 45th MSW (2.00/plant) whereas spiders (2.30spiders/plant) during 48th MSW respectively. The results pertaining to seasonal incidence of insect pests and associated natural enemies in roving survey under sprinkler method of irrigation at Chinnambawi mandal revealed peak population of insect pests (viz., aphids, thrips, leaf hoppers, leaf miner and tobacco caterpillar) during 43rd MSW to 1st MSW and natural enemies (viz., coccinellids and spiders) during 47th and 48th MSW respectively whereas in other mandals (viz., Revally, Peddamandadi and Pungal) peak incidence of insect pests was observed during 47th MSW to 50th MSW respectively whereas peak incidence of natural enemies during 47th MSW to 51st MSW respectively. Understanding these seasonal trends will help in predicting pest outbreaks and optimizing pest management practices to minimize damage and improve yields.

Keywords: Groundnut; natural enemies; survey; seasonal incidence; insect pests.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oil seed and legume crop belongs to family Fabaceae. It is also known as peanut, earthnut, monkey nut, goobers and king of oil seeds. It forms the world's largest source of edible oil and ranks 13th among the food crops and is also fourth most important oil seed crop of the world [1]. Worldwide, groundnut is produced in over 100 countries (both tropical and sub-tropical countries). Asia ranks first in area (63.4 %) and production (71.1%). China is the largest groundnut producer, with 40 percent of worlds production, followed by India (23 %), a group of Sub-Saharan African countries (8.4 %) and the United States (5.6 %).

In India, groundnut is grown in an area of 4.81 million ha with production and productivity of 6.69 million tons and 1393 kg/ha, respectively [2]. It is mainly grown in the southern and north western states viz., Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Madhya Pradesh together occupying about 90 % of the groundnut area in the country. In Telangana, it is grown in an area of 0.13 million ha (2.60 % to all India area) with production of 0.30 million tons (4.41 % to all India production) and productivity of 2364 kg/ha [2]. The major groundnut growing districts in Telangana state are Nagarkurnool, Mahabubnagar, Wanaparthy, Gadwal, Mahabubabad, Suryapet and Vikarabad.

The productive cultivation of groundnut crop is prone to severe constraints by insect pests. The yield is severely affected by the attack on various pests [3]. Among the biotic constraints, insect pests are the most destructive factors for groundnut production as well as oil content and quality. It was estimated that overall, 17% of yield losses occurs due to field pests and 6-10 % because of storage pests [4]. In India, yield loss of about 16 % was recorded in groundnut due to a complex of insect pests, the prominent one being *A. craccivora* [5]. The avoidable yield loss in groundnut due to defoliators is 24.5 %, sucking pests 15.7 % and both defoliator and sucking pests is upto 40.2 per cent. The total loss due to insect pests of groundnut was 47.3 per cent [6].

Mostly groundnut insect pests are sporadic in occurrence and distribution. Although many insect species live and feed on groundnut crop, only a few causes significant damage that result in large reductions in pod and haulm yields. The major insect pests infesting groundnut are the groundnut aphid (*Aphis craccivora* Koch), leaf miner (*Proaerema modicella* Deventer), tobacco caterpillar (*Spodoptera litura* Fab.), red hairy caterpillar (*Amsacta albistriga* Butler), jassid (*Empoasca kerri* Pruthi), thrips (*Scirtothrips dorsalis* Distant), stem borer (*Sphenoptera perotetti* Cameron), white grub (*Holotrichia consanguinea* Blanchard), bihar hairy caterpillar (*Spilosoma obliqua* Walker) and termite

(*Odontotermes obesus* Rambur) as reported by Atwal and Dhaliwal [7]. The insect pests caused significant reduction in mean height of plant (20.50 %), primary branches (24.93 %), pods per plant (25.26 %), kernel per pod (6.80 %) and yield per plot (35.71 %) while increase in mean pod damage (50.99 %) and mean kernel damage (29.61 %) with 35.71 percent loss in pod yield, equivalent to a loss of 8.05 q/ha. Especially, leaf miner infestations are most serious when they damage the growing points of young plants, thereby reducing growth and pod yield (35 to 44 % lower) [8]. The knowledge of incidence of insect pests and their natural enemies at different stages of groundnut crop will be helpful in evolving proper management schedule. The present study was aimed to know seasonal occurrence of insect pests and associated natural enemies of groundnut in conventional as well as sprinkler method of irrigation which helps to plan appropriate management strategies in advance to minimize the crop losses.

2. MATERIALS AND METHODS

The present work was carried out in farmers' fields, Wanaparthy district of Telangana State during *rabi*, 2020-21.

2.1 Fixed Plot Survey

This has been done for the groundnut grown under sprinkler method of irrigation and conventional method of irrigation (one acre each) at Nagapur village, Revally Mandal of

Wanaparthy district. Weekly observations pertaining to insect pests and natural enemies were recorded right from sowing of the crop to till harvest. In each selected field, five spots (1 sq. m area each) were randomly selected such that four are from four corners and one from the centre of the field. Five feet distance alongside of boundary of the field in all the directions was left out as buffer space during observations. At each spot, 10 plants adjacent to each other was selected likewise 50 plants were selected for recording the observations. Details of location for survey are presented in Table 1.

2.2 Roving Survey

The present work has been conducted in farmer fields of one acre each grown under sprinkler method of irrigation as part of roving survey in four mandals (Chinnambavi, Revally, Peddamandadi and Pangal) comprising of two villages from each mandal and five farmers from each village, which are major groundnut growing areas of Wanaparthy District. In each selected field, ten spots (1 sq. m area each) randomly were taken leaving five feet distance alongside of boundary of the field in all the directions as buffer space while recording observations. At each spot, 5 plants adjacent to each other, likewise 50 plants were selected for recording the observations. Details of locations for field study are presented in Table 2.

Table 1. Location selected for fixed plot survey for insect pests and associated natural enemies in *rabi* groundnut at Wanaparthy district

Sl. No	Village	Mandal	District	No. of fields
1	Nagapur	Revally	Wanaparthy	2

Table 2. Locations selected for roving survey for insect pests and associated natural enemies in *rabi* groundnut at Wanaparthy district

Sl. No	District	Mandals	Villages	No. of fields	
1	Wanaparthy	Chinnambavi	Ammaipally	5	
			Dagadapally	5	
Revally		Nagapur	5		
		Revally	5		
3		Peddamandadi	Peddmandadi	5	
			Pamireddypally	5	
4		Pangal	Kadirepad	5	
			Sakhapur	5	
Total					40

2.3 Observations

Fifty plants were randomly selected and observations on incidence of insect pests and associated natural enemies were recorded at weekly intervals during morning hours between 7.00 am to 9.00 am. *Aphids, Thrips and Leaf hoppers*: Number per 3 leaves, one each upper, middle and lower plant canopy and represented as Number/3 leaves /plant. *Groundnut Leaf miner and Tobacco caterpillar*: Number of larvae / plant. *Lady bird Beetle*: Number of grubs and adults per plant. *Spiders*: Number of spiders per plant.

3. RESULTS AND DISCUSSION

The data has been presented in following tables with an interpretation of case-based reasoning. In seasonal incidence studies, insect pests viz., aphids, thrips, leaf hopper, leaf miner, tobacco caterpillar and natural enemies viz., coccinellid beetles and spiders were found to infest groundnut crop at various stages of its growth during *rabi* 2020- 21 both under sprinkler and conventional method of irrigation. Although the incidence of gram pod borer was noticed, it was low during the study period.

3.1 Seasonal Incidence of Insect Pests and Associated Natural Enemy Population in Fixed Plot Survey under Sprinkler Method of Irrigation in Groundnut

Aphids first appeared during 45th Meteorological Standard Week (MSW) (2.80 aphids / 3 leaves / plant) with its peak population at 49th MSW (3.00 aphids /3 leaves / plant) persisted upto 51st MSW (2.20 / 3 leaves / plant) there after no incidence was observed. Thrips incidence commenced from 43rd MSW (2.80 thrips / 3 leaves / plant) with peak population at 44th MSW (3.12 thrips/3 leaves/ plant) persisted up to 3rd MSW with 1.38 thrips/ 3 leaves/ plant later its population declined. The leaf hopper population was observed from 43rd MSW with 2.26 leaf hoppers/ 3 leaves/ plant and gradually reached peak during 44th MSW (2.70 leaf hoppers/ 3 leaves/ plant) and persisted up to 3rd MSW (1.54 leaf hoppers/ 3 leaves/ plant) later its incidence decreased. Leaf miner incidence was recorded from 43rd MSW (2.33 larvae/ plant) with peak infestation at 44th MSW (2.76 larvae/ plant) and

its incidence persisted upto 4th MSW (till harvest) with 1.25 larvae/ plant. The incidence of tobacco caterpillar was recorded from 43rd MSW with 2.48 larvae/ plant and persisted upto 4th MSW with 1.40/ plant (till harvest) with peak infestation at 44th MSW (2.64 larvae/ plant) (Table 3).

The occurrence of natural enemies viz., coccinellid beetles was first appeared during 45th MSW with 1.60/ plant and persisted upto 49th MSW (1.30 /plant) there after its population declined. The incidence of spiders was recorded from 45th MSW with 1.50 spiders /plant and persisted upto 47th MSW (1.30 /plant) there after its population decreased.

3.2 Seasonal Incidence of Insect Pests and Associated Natural Enemy Population in Fixed Plot Survey under Conventional Method of Irrigation in Groundnut

The results pertaining to the seasonal incidence of insect pests infesting groundnut crop and associated natural enemies under conventional method (flooding) of irrigation is given in Table 4.

The data pertaining to aphid incidence revealed that the pest incidence was noticed from 43rd MSW (3.90 aphids/3 leaves/plant) with its peak infestation at 44th MSW (5.30 aphids /3leaves/plant) and persisted upto 48th MSW (2.10 aphids / 3 leaves/plant) there after nil incidence was observed. Thrips population was recorded from 43rd MSW (1.70 thrips/3 leaves/plant) with its peak incidence at 49th and 52nd MSW (2.40 thrips/3 leaves/plant), persisted upto 4th MSW (1.50 thrips/ 3 leaves/plant) i.e., till the harvest of the crop. The leaf hopper incidence was recorded from 43rd MSW (1.80 leaf hoppers/3 leaves/plant) with its peak incidence at 52nd MSW (2.60 /3 leaves/plant) and persisted till harvest of the crop (4th MSW with 1.60 leaf hoppers/3 leaves/plant). Leaf miner incidence was recorded from 43rd MSW (1.50 larvae/ plant) with peak infestation at 50th to 52nd MSW with (2.50/ plant) and persisted up to 4th MSW (1.40 larvae/ plant) i.e., till harvest of the crop. The incidence of tobacco caterpillar was noticed from 43rd MSW with 1.90 larvae/ plant and persisted till the harvest of the crop (4th MSW) with 1.30 larvae/ plant with its peak incidence at 49th MSW (2.70 larvae/plant).

The coccinellids population were recorded from 43rd MSW with 1.40 grubs and adults/plant and its peak population was recorded during 45th MSW (2.00/ plant) and persisted up to 49th MSW (1.00/ plant) there after its population declined. The incidence of spiders was noticed from 43rd MSW with 1.50 /plant and peak incidence at 48th MSW (2.30 spiders/plant) persisted up to 49th MSW with 1.50 spiders/plant, there after its population decreased.

Fixed plot survey data revealed that the population pertaining to insect pests and natural enemies in groundnut crop grown both under sprinkler and conventional (furrow) method of irrigation was low during *rabi* 2020-21 which indicates that pest population is uniform irrespective of method of irrigation.

3.3 Seasonal Incidence of Insect Pests and Associated Natural Enemies of *rabi* Groundnut in Roving Survey under Sprinkler Method of Irrigation

The insect pests *viz.*, aphids, thrips, leaf hoppers, leaf miner and tobacco caterpillar and natural enemies *viz.*, coccinellid beetles and spiders were found to infest groundnut crop at various stages of its growth during *rabi* 2020-21. Although the incidence of gram pod borer was noticed, it was low during the study period.

3.4 Chinnambawi Mandal

The incidence of aphids was recorded from 43rd MSW (5.20 aphids/3 leaves/ plant) with peak population at 47th MSW (6.06 / 3 leaves / plant) and persisted upto 3rd MSW (2.93 /3 leaves/plant) there after nil incidence was observed. The infestation of thrips was recorded from 43rd MSW (4.87 thrips / 3 leaves / plant) with its peak incidence at 49th MSW (5.45 thrips / 3 leaves / plant) and persisted up to 4th MSW with 0.75 thrips / 3 leaves / plant *i.e.*, till crop harvest. The leaf hopper population was observed from 43rd MSW with 6.15 leaf hoppers / 3leaves / plant) persisted upto 4th MSW (1.25 leaf hoppers / 3 leaves/plant) *i.e.*, till the harvest of the crop. Leaf miner incidence was recorded from 43rd MSW (2.33 larvae / plant) with peak infestation at 2nd MSW (2.40 larvae / plant) and persisted till harvest of the crop (4th MSW with 0.85 larvae / plant). The incidence of tobacco caterpillar was noticed from

43rd MSW with 1.02 larvae / plant and persisted upto 4th MSW *i.e.*, till crop harvest (0.81 / plant) with its peak incidence at 48th MSW (1.95 larvae / plant) (Table 5).

The survey results pertaining to the incidence of grubs and adults of coccinellid beetles revealed that its incidence was recorded from 44th MSW (0.66 / plant) with peak population at 47th MSW (1.46 / plant), persisted up to 3rd MSW (0.1 / plant) there after its incidence decreased. The incidence of spiders was noticed from 45th MSW with 0.92 / plant and its peak incidence at 48th MSW with 1.19 / plant, persisted upto 3rd MSW (0.20 spiders / plant) there after its population decreased.

3.5 Revally Mandal

The aphid incidence was recorded from 43rd MSW (1.88 aphids/3 leaves / plant) with its peak population at 47th MSW (4.58/ 3 leaves/ plant) and persisted upto 3rd MSW (0.82 aphids/3 leaves/plant) there after nil incidence was observed. Infestation of thrips was recorded from 43rd MSW (0.92 thrips/3 leaves/plant) with its peak infestation at 52nd MSW (2.27 /3 leaves/plant) and persisted upto 3rd MSW with 1.02 thrips/ 3 leaves/ plant thereafter its population declined. The leaf hopper population was observed from 47th MSW (1.25 leaf hoppers/ 3 leaves/ plant) with its peak incidence at 49th MSW (1.86 / 3 leaves/ plant) and persisted upto 52nd MSW (1.62/ 3 leaves/plant) thereafter its incidence was nil. Leaf miner incidence was recorded from 46th MSW (0.59 larvae/plant) with peak infestation at 50th MSW (1.75 larvae/plant) and persisted upto 3rd MSW (1.22 larvae/ plant), thereafter its population has decreased. The incidence of tobacco caterpillar was noticed from 45th MSW with 0.57 larvae/ plant, persisted upto 2nd MSW (1.20/plant) with its peak incidence at 49th MSW (1.55 larvae/ plant), thereafter its population was decreased at harvest (Table 6).

The incidence of coccinellid beetles was recorded from 43rd MSW with 0.62 beetles/ plant and its peak population at 47th MSW (1.26/plant) and persisted upto 51st MSW (0.10/plant), there after its population declined. The incidence of spiders was recorded from 44th MSW with 0.50 spiders/ plant and its peak population at 49th MSW (1.22/plant), persisted upto 1st MSW (0.50/plant), there after its population decreased.

Table 3. Seasonal incidence of insect pests and associated natural enemies in fixed plot survey under sprinkler method of irrigation in groundnut (Rabi 2020-21)

Meteorological Standard Week (MSW)	Mean* insect population					Natural enemies (no./plant)	
	Aphid (no./3 leaves/plant)	Thrips (no./3 leaves/plant)	Leaf hopper (no./3 leaves/plant)	Leaf miner (no./plant)	Tobacco Caterpillar (no./plant)	Coccinellids	Spiders
42	0.00	0.00	0.00	00.0	0.00	0.00	0.00
43	0.00	2.80	2.26	2.33	2.64	0.00	0.00
44	0.00	3.12	2.70	2.76	2.48	0.00	0.00
45	2.80	2.44	2.32	2.30	2.18	1.60	1.50
46	2.60	2.22	2.12	2.30	2.00	1.30	1.00
47	2.80	1.72	1.48	2.16	1.92	1.00	1.30
48	2.20	1.62	1.46	1.60	1.46	1.00	0.00
49	3.00	1.52	1.58	1.48	1.32	1.30	0.00
50	2.60	1.74	1.82	1.68	1.52	0.00	0.00
51	2.20	1.80	1.92	1.62	1.60	0.00	0.00
52	0.00	1.48	1.36	1.32	1.60	0.00	0.00
1	0.00	1.58	1.42	1.64	2.30	0.00	0.00
2	0.00	1.46	1.64	2.02	2.00	0.00	0.00
3	0.00	1.38	1.54	1.62	1.76	0.00	0.00
4	0.00	0.00	0.00	1.25	1.40	0.00	0.00

* Mean of 50 plants

Table 4. Seasonal incidence of insect pests and associated natural enemies in groundnut in fixed plot survey under conventional method of irrigation in groundnut (Rabi 2020-21)

Meteorological Standard Week (MSW)	Mean* insect population					Natural enemies (no./plant)	
	Aphid (no./3 leaves/plant)	Thrips (no./3 leaves/plant)	Leaf hopper (no./3 leaves/plant)	Leaf miner (no./plant)	Tobacco Caterpillar (no./plant)	Coccinellids	Spiders
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	3.90	1.70	1.80	1.50	1.90	1.40	1.50
44	5.30	1.50	1.60	1.70	2.10	1.70	1.30
45	4.10	2.00	2.00	2.20	2.30	2.00	1.50
46	2.20	2.00	2.00	2.40	2.30	1.00	1.00
47	2.70	2.00	2.00	2.40	2.60	1.80	1.30
48	2.10	1.90	2.20	2.40	2.50	1.80	2.30
49	0.00	2.40	2.20	2.40	2.70	1.00	1.50
50	0.00	1.80	2.10	2.50	2.30	0.00	0.00
51	0.00	2.00	1.60	2.50	2.50	0.00	0.00
52	0.00	2.40	2.60	2.50	2.50	0.00	0.00
1	0.00	1.50	2.00	2.10	2.00	0.00	0.00
2	0.00	1.60	2.00	2.00	2.00	0.00	0.00
3	0.00	1.20	1.30	1.40	1.70	0.00	0.00
4	0.00	1.50	1.60	1.40	1.30	0.00	0.00

* Mean of 50 plants

Table 5. Seasonal incidence of major insect pests and natural enemies in groundnut in roving survey under sprinkler method of irrigation at Chinnambawi mandal (Rabi 2020-21)

Meteorological Standard Week (MSW)	Mean* insect population					Natural enemies (no./plant)	
	Aphid (no./3 leaves/plant)	Thrips (no./3 leaves/plant)	Leaf hopper (no./3 leaves/plant)	Leaf miner (no./plant)	Tobacco Caterpillar (no./plant)	Coccinellids	Spiders
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	5.20	4.87	6.15	2.33	1.02	0.00	0.00
44	5.17	4.54	5.41	2.30	0.87	0.66	0.00
45	5.08	4.69	5.13	2.08	1.67	0.77	0.92
46	5.39	5.23	5.13	2.09	1.86	1.40	0.83
47	6.06	5.21	5.12	2.31	1.79	1.46	1.18
48	5.62	5.24	5.45	2.25	1.95	1.20	1.19
49	5.70	5.45	5.26	2.17	1.83	1.33	1.04
50	5.03	4.72	5.61	1.98	1.76	1.10	1.16
51	5.23	5.03	5.25	2.03	1.81	0.98	0.77
52	5.25	5.03	5.35	1.94	1.58	0.85	0.70
1	5.84	5.36	5.97	1.95	1.46	0.63	0.66
2	5.63	4.82	5.93	2.40	1.48	0.27	0.43
3	2.93	3.30	5.16	2.16	1.79	0.10	0.20
4	0.00	0.75	1.25	0.85	0.81	0.00	0.00

* Mean of 50 plants

Table 6. Seasonal incidence of insect pests and natural enemies in groundnut in roving survey under sprinkler method of irrigation at Revally mandal (Rabi 2020-21)

Meteorological Standard Week (MSW)	Mean* insect population					Natural enemies (no./plant)	
	Aphid (no./3 leaves/plant)	Thrips (no./3 leaves/plant)	Leaf hopper (no./3 leaves/plant)	Leaf miner (no./plant)	Tobacco Caterpillar (no./plant)	Coccinellids	Spiders
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	1.88	0.92	0.00	0.00	0.00	0.62	0.00
44	1.74	0.99	0.00	0.00	0.00	0.75	0.50
45	1.73	0.67	0.00	0.00	0.57	1.15	0.75
46	3.33	1.72	0.00	0.59	0.70	0.41	0.50
47	4.58	1.75	1.25	0.67	0.67	1.26	0.75
48	3.81	2.09	1.50	0.74	1.42	0.82	1.12
49	3.84	1.90	1.86	1.22	1.55	1.08	1.22
50	3.10	1.84	1.40	1.75	1.44	0.00	0.00
51	2.66	1.75	1.39	1.56	1.27	0.10	0.10
52	2.73	2.27	1.62	1.31	1.10	0.00	0.17
1	2.60	1.70	0.00	1.48	1.33	0.00	0.50
2	2.20	1.31	0.00	1.34	1.20	0.00	0.00
3	0.82	1.02	0.00	1.22	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Mean of 50 plants

Table 7. Seasonal incidence of insect pests and natural enemies in groundnut in roving survey under sprinkler method of irrigation at Peddamandadi mandal (Rabi 2020-21)

Meteorological Standard Week (MSW)	Mean* insect population					Natural enemies (no./plant)	
	Aphid (no./3 leaves/plant)	Thrips (no./3 leaves/plant)	Leaf hopper (no./3 leaves/plant)	Leaf miner (no./plant)	Tobacco Caterpillar (no./plant)	Coccinellids	Spiders
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	1.38	1.60	0.00	0.00	0.00	0.00	0.00
45	2.95	1.40	0.71	0.00	0.61	0.41	0.50
46	2.61	1.39	1.23	1.61	0.72	0.62	0.75
47	4.27	1.76	1.25	1.48	1.55	1.26	1.12
48	3.27	1.61	1.49	1.55	1.47	0.75	1.00
49	3.13	1.59	1.81	1.57	1.67	0.50	0.50
50	2.84	1.70	1.38	2.26	1.68	0.10	0.10
51	1.91	1.70	1.29	1.91	1.34	0.00	0.00
52	0.00	1.70	0.83	1.32	1.09	0.00	0.00
1	0.00	1.57	0.00	1.52	1.30	0.00	0.00
2	0.00	0.54	0.00	1.22	1.25	0.00	0.00
3	0.00	0.00	0.00	0.56	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Mean of 50 plants

Table 8. Seasonal incidence of insect pests and natural enemies in *Rabi* groundnut in roving survey under sprinkler method of irrigation at Pangal mandal (*Rabi* 2020-21)

Meteorological Standard Week (MSW)	Mean* insect population					Natural enemies (no./plant)	
	Aphid (no./3 leaves/plant)	Thrips (no./3 leaves/plant)	Leaf hopper (no./3 leaves/plant)	Leaf miner (no./plant)	Tobacco Caterpillar (no./plant)	Coccinellids	Spiders
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	1.45	0.00	0.00	0.00	0.00	0.00	0.00
44	2.27	1.51	1.31	0.00	0.56	0.00	0.00
45	2.20	1.42	1.53	0.00	1.14	0.00	1.00
46	2.47	1.66	1.46	1.58	1.35	0.00	0.62
47	3.61	1.73	1.39	1.62	1.48	0.10	1.10
48	3.01	1.51	1.66	1.67	1.52	0.41	0.50
49	3.05	1.61	2.21	1.83	1.65	0.62	0.75
50	3.01	1.71	1.51	2.24	1.60	1.26	0.00
51	1.88	1.63	1.32	1.98	1.31	1.50	0.00
52	0.91	1.60	0.00	1.45	1.15	0.00	0.00
1	0.00	1.64	0.00	1.48	1.26	0.00	0.00
2	0.00	1.71	0.00	1.24	0.00	0.00	0.00
3	0.00	1.58	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Mean of 50 plants

3.6 Peddamandadi Mandal

Aphids first appeared during 44th MSW (1.38 aphids/ 3 leaves/ plant) with its peak incidence at 47th MSW (4.27 aphids/3 leaves/plant) and persisted upto 51st MSW (1.91 aphids/3 leaves/plant) there after nil incidence was observed. Thrips incidence was noticed from 44th MSW (1.6 thrips/ 3leaves/plant) with its peak at 47th MSW (1.76 / 3 leaves/plant) and persisted upto 2nd MSW with 0.54 thrips/ 3 leaves/ plant, thereafter nil incidence was recorded. The leaf hopper population was observed from 45th MSW (0.71 leaf hoppers/ 3 leaves/ plant) with its peak incidence at 49th MSW (1.81 leaf hopper / 3 leaves/ plant) and persisted up to 52nd MSW (0.83 leaf hoppers/ 3 leaves/ plant), thereafter its incidence declined. Leaf miner incidence was recorded from 46th MSW (1.61 larvae/plant) with peak infestation at 50th MSW (2.26 larvae/plant) and persisted upto 3rd MSW (0.56 larvae/ plant), thereafter nil incidence was recorded. The incidence of tobacco caterpillar was noticed from 45th MSW with 0.61 larvae/ plant and persisted upto 2nd MSW (1.25/plant) with its peak incidence at 50th MSW (1.68 larvae/ plant) and then its incidence was declined (Table 7).

Incidence of coccinellid beetles was noticed from 45th MSW with 0.41 /plant and its peak population at 47th MSW (1.26 /plant), persisted up to 50th MSW with 0.10/plant, there after its incidence declined. The incidence of spiders was recorded from 45th MSW with 0.50 spiders /plant and its peak population at 47th MSW with 1.12/ plant, persisted upto 50th MSW with 0.10/plant and then nil population was observed.

3.7 Pangal Mandal

Aphids first appeared during 43rd MSW (1.45 aphids/3 leaves/ plant) with its peak incidence at 47th MSW (3.61 /3 leaves/plant) and persisted upto 52nd MSW (0.91 aphids/3 leaves/plant) there after nil incidence was recorded. Infestation of thrips was recorded from 44th MSW (1.51 thrips/3 leaves/plant) with its peak incidence at 47th MSW (1.73 thrips/ 3 leaves/plant) and persisted upto 3rd MSW with 1.58 thrips/ 3leaves/ plant, then nil population was observed. The leaf hopper population was observed from 44th MSW (1.31 leaf hoppers/ 3 leaves/ plant) with its peak incidence at 49th MSW (2.21 leaf hoppers/ 3 leaves/ plant), persisted up to 51st MSW (1.32 leaf hoppers/ 3 leaves/plant) and then nil

incidence was recorded. Leaf miner incidence was recorded from 46th MSW (1.58 larvae/plant) with peak infestation at 50th MSW (2.24 larvae/plant) and persisted upto 2nd MSW (1.24 larvae/ plant), then nil population was recorded. The incidence of tobacco caterpillar was noticed from 44th MSW with 0.56 larvae/ plant and persisted upto 1st MSW with 1.26/plant with its peak incidence at 49th MSW (1.65 larvae/ plant), thereafter no population was recorded (Table 8).

Coccinellids incidence was recorded from 47th MSW (0.10/plant) and persisted up to 51st MSW with 1.50/plant, there after its population declined. The incidence of spiders was noticed from 45th MSW (1.00 spiders /plant) and its peak population was recorded at 47th MSW (1.10/plant) persisted upto 49th MSW 0.75/plant there after nil population was recorded.

Seasonal incidence data pertaining to insect pests and associated natural enemy population recorded on groundnut crop in roving survey under sprinkler method of irrigation was found to be low and uniform except for Chinnambawi mandal wherein leaf miner incidence just crossed Economic Threshold Level (ETL) of 2-3 larvae/plant (National Centre for Integrated Pest Management, [9].The survey results also revealed that the pest infestation is uniform across mandals, method of survey and method of irrigation. Wherever the literature on seasonal incidence of insect pests and natural enemies in *rabi* groundnut is scanty, literature on other crops was discussed. The current results pertaining to aphid incidence were in line with the findings of Akashe et al. [10] who reported aphid incidence from 4th week of October in safflower at Maharashtra.

Whereas, Saritha et al., [11] reported aphid incidence in groundnut from 51st MSW to 9th MSW at Andhra Pradesh. Kandakoor et al. [12] revealed aphid incidence from last week of July to last week of October in groundnut at Karnataka. Gocher and Ahmad [13] observed aphid incidence from last week of July (31th MSW) with peak in the second week of September (37th MSW) and persisted upto 43rd MSW. Nayak et al. [14] documented groundnut aphid incidence from 33rd MSW *i.e.*, first fortnight of August and reached peak in the first week of September (36th MSW) and persisted upto 39th MSW later the aphid population decreased. The cited literature is in contrary to the present findings. The variation

might be attributed to sowing season and variety selected.

The reported results pertaining to thrips incidence are in line with the results of Deepika et al., 2019 who recorded thrips incidence in okra during 44th MSW persisted upto 3rd MSW at Tamil Nadu while contradictory results were reported by Saritha et al. [11] Kandakoor et al. (2012) and Nayak et al. [14].

The results pertaining to leaf hopper incidence were supported by the research findings of Deepika et al., 2019 who recorded 0.30 leaf hoppers / 3 leaves/ plant during 43rd MSW and persisted upto 4th MSW (1.85 leaf hoppers/ 3 leaves/ plant) while Saritha et al., 2020 reported the incidence of leaf hopper from 51st MSW and persisted upto 12th MSW in *rabi* groundnut at Andhra Pradesh. Harish et al., 2014 recorded peak incidence at 8th MSW at Gujarat in *rabi* groundnut. Nayak et al., 2019 reported incidence of leaf hoppers during 33rd MSW (1.68/ top 3 leaves) with peak during 37th MSW with 5.68 hoppers/ top 3 leaves thereafter reached to minimum during 43rd MSW in groundnut at Chhattisgarh.

The survey results reported the incidence of leaf miner from 43rd MSW in fixed plot survey and from 47th MSW in roving survey except in Chinnambawi mandal wherein its incidence was reported from 43rd MSW. Contradictory results were reported by Pazhaniswamy and Hariprasad [15] who documented leaf miner incidence from 4th MSW (1.1 larvae / plant) and persisted up to 12th MSW with 2.1 larvae / plant with peak incidence (5.9 larvae / plant) during 8th MSW in *rabi* groundnut at Tamil Nadu while Praveen [16] reported leaf miner incidence from February 1st fortnight to April 2nd fortnight with a peak population during March 2nd fortnight in groundnut at Karnataka. The varied results might be attributed to sowing season and variety selected.

Ahir et al. [17] revealed the incidence of tobacco caterpillar during 37th MSW with mean population of 0.20 larvae/plant and peak level at 41st MSW (1.40 larvae/plant) thereafter, the population reached to a minimum level of 0.40 larvae/plant during 43rd MSW in groundnut at Rajasthan. The varied results might be attributed to sowing season and variety selected.

With respect to coccinellid beetles, its population was noticed from 45th MSW to 50th MSW. The survey results were supported by the findings of

Deepika et al. 2019 who reported coccinellid population in okra from 45th MSW with 0.05 beetles /plant and reached peak level during 46th MSW (0.45 / plant) in okra at Tamil Nadu. While, Nayak et al. [14] reported coccinellid beetle incidence from 32nd MSW with mean population of 0.12 /plant and its peak incidence during 3rd week of September (0.96/plant) thereafter, the population gradually declined and reached minimum level of 0.32/plant during 44th MSW in groundnut at Chhattisgarh. The varied results may be due to variation in pest incidence.

The reported results with respect to spider population were supported by the findings of Deepika et al. [18] who documented spiders in okra from 43rd MSW with 0.05 spiders /plant and its peak level during 52nd MSW (0.70 / plant) while Gaikwad et al., [19] noticed spiders during 32nd MSW with 0.20 / plant and its peak (1.02 /plant) during 40th MSW (first week of October) in okra at Maharashtra. The contradictory results might be due to variation in pest incidence upon which these natural enemies feed [20].

4. CONCLUSION

The studies on seasonal incidence of insect pests and associated natural enemies in fixed plot survey under sprinkler method of irrigation revealed peak population of insect pests viz., aphids (3.00 /3leaves/plant), thrips (3.12 /3 leaves/plant) leaf hopper (2.70 / 3 leaves/ plant), leaf miner with 2.76 larvae/plant and tobacco caterpillar (2.64 larvae/ plant) during 49th MSW, 44th MSW, 44th MSW, 44th MSW and 44th MSW, respectively whereas the peak incidence of grubs and adults of coccinellid beetles noticed from 45th MSW with 1.60/ plant and persisted upto 49th MSW with 1.30/plant whereas peak incidence of spiders was noticed from 45th MSW with 1.50 spiders /plant and persisted upto 47th MSW (1.30 /plant).

The survey results pertaining to insect pest and natural enemies in groundnut crop in fixed plot survey under conventional method of irrigation revealed that the peak population of insect pests viz., aphids (5.30 /3 leaves/plant), thrips (2.40 /3 leaves/plant) leaf hopper (2.60 / 3 leaves/ plant), leaf miner with 2.50 larvae/plant and tobacco caterpillar (2.70 larvae/ plant) during 44th MSW, 49th and 52nd MSW, 52nd MSW, 50th to 52nd MSW and 49th MSW, respectively while peak incidence of natural enemies viz., grubs and adults of coccinellid beetles was observed at 45th MSW (2.00 / plant) whereas spiders (2.30 /plant) during

48th MSW. Fixed plot survey data revealed that the population pertaining to insect pests and natural enemies in groundnut crop grown both under sprinkler and conventional method of irrigation was low and uniform during *rabi* 2020-21 irrespective of method of irrigation.

In roving survey under sprinkler method of irrigation at Chinnambawi mandal revealed peak population of insect pests *viz.*, aphids (6.06 /3 leaves/plant) during 47th MSW, thrips (5.36 / 3 leaves / plant) during 1st MSW, leaf hoppers (6.15 / 3 leaves / plant) and leaf miner (2.33 larvae / plant) during 43rd MSW and tobacco caterpillar (1.95 larvae / plant) during 48th MSW respectively. While, peak incidence of coccinellid beetles and spiders were noticed during 47th MSW and 48th MSW with 1.46/ plant and 1.19/plant, respectively.

With respect to Revally mandal, the results revealed peak incidence of insect pests *viz.*, aphids (4.58 /3 leaves/plant) during 47th MSW, thrips (2.08 / 3 leaves / plant) during 48th MSW, leaf hoppers (1.86 /3 leaves / plant) and tobacco caterpillar (1.55 larvae / plant) during 49th MSW, respectively, leaf miner (1.75 larvae / plant) during 50th MSW. The peak incidence of coccinellid beetles and spiders were noticed at 47th MSW (1.26/ plant) and 49th MSW (1.22/plant), respectively.

At Peddamandadi mandal, results revealed peak incidence of aphids (4.27 / 3 leaves/plant) and thrips (1.76 / 3 leaves / plant) during 47th MSW, respectively, leaf hoppers (1.81 /3 leaves / plant) during 49th MSW, leaf miner (2.26 larvae / plant) and tobacco caterpillar (1.68 larvae / plant) during 50th MSW, respectively. The peak incidence of coccinellid beetles and spiders were noticed during 47th MSW with 1.26/ plant and 1.12/plant, respectively.

At Pangal mandal, peak population of aphids (3.61 /3 leaves/plant) and thrips (1.73 /3 leaves / plant) were observed during 47th MSW, respectively, leaf hoppers (2.21 / 3 leaves / plant) and tobacco caterpillar (1.65 larvae / plant) during 49th MSW, respectively and leaf miner (2.24 larvae / plant) during 50th MSW. With respect to natural enemies, peak incidence of coccinellid beetles and spiders were noticed during 51st MSW and 47th MSW with 1.50/ plant and 1.10/plant, respectively. Seasonal incidence data pertaining to insect pests and associated natural enemy population across mandals were found to be low and uniform except for

Chinnambawi mandal wherein leaf miner incidence just crossed Economic Threshold Level (ETL) of 2-3 larvae / plant. The results also revealed that the pest infestation is uniform across mandals and survey methods (fixed plot and roving survey).

5. FUTURE SCOPE

It helps in refining predictive models for pest outbreaks based on climatic variables, exploring the potential of natural enemies as biological control agents, and enhancing IPM protocols by incorporating the timing of pest and natural enemy interactions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ramanathan T. Genetic improvement of groundnut. 2001;12:260).
2. Agricultural Statistics at a Glance. Government of India. Ministry of Agriculture and Farmers Welfare, Directorate of Economics and Statistics, New Delhi. 2019;10(5) :335.
3. Kumar S, Prasad S, Siugh RN. Resurgence of two spotted mite, *Tetranychus urticae* Koch (Acarina: Tetranychidae) due to acaricides and botanicals on okra. Annals of Plant Protection Sciences. 2002;10(2):239- 242.
4. Jagtap AB, Ghule BD, Deokar AB. Assessment of losses in yield of 'Phule Pragati' groundnut caused by insect pests; 1984.
5. Reddy LJ, McDonald D. Research strategies for increased groundnut production in India. In national seminar on strategies of increased production of oilseed and edible oils. National Productivity Council, New Delhi., during (mimeographed). 1984 ;23.
6. Baskaran RK, Rajavel DS. Yield loss by major insect pests in groundnut. Annals of

- Plant Protection Sciences. 2013;21(1): 189-190.
7. Atwal AS, Dhaliwal GS. Agricultural pests of South Asia and their management. Kalyani Publishers; 2015.
 8. Shanower TG, Gutierrez AP, Wightman JA. Impact of the groundnut leafminer, *Aproaerema modicella* (Deventer) (*Lepidoptera: Gelechiidae*) on growth and yield of two groundnut cultivars. International Journal of Tropical Insect Science. 1995;16(1):87-91.
 9. National Centre for Integrated Pest Management. HORTSAP USER Manual. 2014;60. Available:<http://www.ncipm.res.in/Horticulture/pdf/HORTSAP%20USER-Manual-2014-15.pdf>.
 10. Akashe VB, Deokar CD, Patil MW, Shewale MR. Seasonal incidence of aphid *Uroleucon compositae* in safflower; 1965.
 11. Saritha R, Sirisha ABM, Haseena SK, Sujatha V. Impact of weather on incidence of sucking pests in groundnut. Journal of Entomology and Zoology Studies. 2020;8(3):1157-1163.
 12. Kandakoor SB, Khan HK, Gowda GB, Chakravarthy AK, Kumar CA, Venkataravana P. The Incidence and Abundance of Sucking Insect Pests on Groundnut; 2012.
 13. Gocher S, Ahmad S. Seasonal incidence of major sucking insect pests of groundnut in relation to weather parameters of semi-arid region of India. International Journal of Current Microbiology and Applied Sciences. 2019;8(08):1106-1111.
 14. Nayak TK, Deole S, Shaw SS, Mehta N. Seasonal incidence of sucking insect pests infesting groundnut crop at Raipur (Chhattisgarh). Journal of Entomology and Zoology Studies. 2019;7(6):83-87.
 15. Pazhanisamy M, Hariprasad Y. Seasonal incidence of leaf miner, *Aproaerema modicella* (Deventer) in groundnut ecosystem in Ariyalur district of Tamil Nadu, India. Plant Archives. 2014;14(1):55-58.
 16. Praveen YV. Studies on groundnut leaf miner *Aproaerema modicella* Deventer. in Northern dry zone of Karnataka. M. Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka (India); 2010.
 17. Ahir KC, Saini A, Rana BS. Seasonal incidence of tobacco caterpillar, *Spodoptera litura* Fab. infesting groundnut (*Arachis hypogaea* L.). International Journal of Pure & Applied Bioscience. 2017;5(2):267-271.
 18. Deepika D, Razak TA, Elanchezhyan K, Manivannan MI. Effect of Abiotic Factors on the Incidence of Major Pests of Okra (*Abelmoschus esculentus*) and Natural Enemies. Madras Agricultural Journal. 2019;106 :1.
 19. Gaikwad BB, Bhosle BB, Sapkal, SD. Seasonal incidence of natural enemies of insect pests on okra. Journal of Entomology and Zoology Studies. 2020;8(3):365-368.
 20. Harish G, Nataraja MV, Jasrotia P, Holajjer P, Savaliya SD, Gajera M. Impact of weather on the occurrence pattern of insect pests on groundnut. Legume Research-An International Journal. 2015; 38(4):524-535.

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The peer review history for this paper can be accessed here:
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