*J. Farm Sci., 36(1): (53-58) 2023*

**RESEARCH PAPER**

# Assessment of incidence of sesamum phyllody and population dynamics of its vector in northern Karnataka

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*(Received: November, 2022 ; Accepted: January, 2023)*

**Abstract:** The present investigation was conducted to study the incidence of sesamum phyllody disease in major sesamum growing areas in northern Karnataka (Vijayapur and Bagalkot districts) which revealed that the sesamum phyllody incidence ranged from 8.00 to 50.45 per cent in both the districts. Among them, Bagalkot recorded highest mean disease incidence of 25.77 per cent followed by Vijayapur with mean disease incidence of 22.73 per cent. In Vijayapur district, the survey was conducted in six taluks. Amongst the taluks, highest average per cent disease incidence was observed in Muddebihal taluk (27.54%) and least incidence was recorded in Indi taluk (16.25%). In Bagalkot district, the survey was conducted in 6 taluks. Among them, the highest average per cent disease incidence was observed in Hungund taluk (31.98%) and the lowest average per cent disease incidence (19.91%) was recorded in Jamkhandi taluk. In order to know the population dynamics of leaf hopper transmitting sesamum phyllody, a study was conducted at College of Agriculture Vijayapur during *kharif* 2021. A set of five traps were installed each week and it was repeated till the harvest of the crop. Studies on the relative abundance of different leaf hoppers found in sesamum ecosystem revealed that *Orosius albicinctus* distant was the most abundant species found in sesamum field with the relative abundance of 64.92 per cent. The maximum population of *O. albicinctus* distant was observed during 36$^{th}$ and 38$^{th}$ standard meteorological weeks (SMWs).

**Key words:** Incidence, Leaf hopper, Phyllody, Population dynamics, Sesamum

## Introduction

Sesamum (*Sesamum indicum* L.) is one of the oldest oil seed crops and has been cultivated since ancient days. Sesamum is a diploid species with 2n = 26 chromosomes, belongs to the family Pedaliaceae which consists of 16 genera and 60 species, but only *Sesamum indicum* has been recognized as cultivated species. In India, sesamum is grown in an area of 1723 lakh ha with 817 lakh tonnes of production and productivity of 474 kg/ha. In Karnataka, sesamum is grown in an area of 22.00 lakh ha with production of 20.26 lakh tonnes and productivity of 921 kg/ha (Anon., 2021). Sesamum crop suffers from many fungal, bacterial and phytoplasma diseases like Phytophthora blight, root rot, bacterial blight, Cercospora leaf spot, Alternaria leaf spot, powdery mildew and phyllody *etc.* Amongst all the diseases, phyllody is a very serious disease in most sesamum growing regions and it is responsible for decrease in sesamum yield (Manjunatha *et al.,* 2012). Due to sesamum phyllody, a yield loss up to 34.00 per cent or even 100.00 per cent in case of severe incidence has been observed (Sarwar and Haq, 2006). Earlier the cause of disease was assumed to be a virus, which was later confirmed as 'mycoplasma like organisms' (MLOs) and termed as phytoplasmas (Das and Mitra, 1998). Sesamum phyllody was first reported in Burma (Myanmar) and was designated as "Green flowering disease" (McGibbon, 1924). Later, it was reported in India as plant showing phyllody like symptoms and was called as sepaloidy and stenosis (Kashiram, 1930). Phyllody means transformation of flowers into green leaf like structures. Transmission of sesame phyllody disease occurs by leaf hopper, *Orosius albicinctus* Distant. In addition to the insect vectors, the disease can be transmitted by the parasitic dodder and grafting of infected material to healthy plant, but it is not transmitted through sap and seed (Gogoi *et al.,* 2017). Sesamum phyllody is becoming a major threat to sesamum cultivation in recent years in northern parts of Karnataka. So, the present investigation on survey for the incidence of sesamum phyllody and population dynamics of its vector was undertaken during the research.

## Material and methods

### Survey for the incidence of sesamum phyllody

To know the occurrence and distribution of sesamum phyllody, a roving survey was conducted in Vijayapur and Bagalkote districts of northern Karnataka during *kharif* 2021. The taluks covered under roving survey in Bagalkot districts were Badami, Bagalkot, Guledagudda, Hungund, Mudhol and Jamkhandi. In Vijayapur district, Talikoti, Vijayapur, Muddebihal, Indi, Devara Hipparagi and Basavana Bagewadi taluks were surveyed. The diagnosis of the disease in the field was based on the symptoms on the plant. The per cent disease incidence was recorded by selecting 10 rows in the field and by counting the total number of plants and number of plants showing phyllody disease symptoms using the formula given below

$$\text{Per cent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

The other information with respect to type of varieties grown, cropping system followed and type of symptoms exhibited by the crop *etc*., were recorded.

### Population dynamics of the leaf hoppers transmitting sesamum phyllody

Population dynamics of the vector, leaf hopper on sesamum causing phyllody disease was studied at College of Agriculture, Vijayapur during *kharif* 2021. Studies on population dynamics of the vectors was done by installing yellow sticky traps in

10 m x 10 m area of sesamum field. A set of five traps were installed each week above the crop canopy. These traps were removed after seven days of installation in the field and the leaf hoppers were collected and their numbers were recorded from each trap at weekly intervals and it was repeated till the harvest of crop. To measure the percentage of individuals of a particular species of leaf hopper among all the species, following formula was used:

$$RA = \frac{n_i}{N}$$

Where, RA= Relative Abundance

$n_i$ = Total number of individuals in the particular sample / species

N = Total population of all the species

The meteorological data *viz*., temperature, humidity, rainfall and bright sunshine hours during the cropping period was obtained from the Meteorological Observatory, RARS, Vijayapur. A simple correlation was worked out between the population of leaf hopper and abiotic environmental factors.

**Results and discussion**

A total of 72 villages were surveyed, 39 villages in Bagalkot district and 33 villages in Vijayapur district were covered. In the field, the diagnosis was done based on the symptoms appeared on plants. The disease incidence of sesamum phyllody ranged from 8.00 to 50.45 per cent in Vijayapur and Bagalkot districts. Among the two districts, Bagalkot recorded highest mean disease incidence of 25.77 per cent followed by Vijayapur with mean disease incidence of 22.73 per cent. In Vijayapur district, the survey was conducted in six taluks. Amongst the taluks, highest average per cent disease incidence was observed in Muddebihal taluk (27.54%) followed by Vijayapur (24.13%), Basavana Bagewadi (24.12%), Talikoti (23.15%), Devara Hipparagi (21.24%) and least incidence was recorded in Indi taluk (16.25%). In Bagalkote district, the survey was conducted in 6 taluks. Among them, the highest average per cent disease incidence was observed in Hungund taluk (31.98%) followed by Badami taluk (29.16%), Mudhol taluk (27.35%), Guledagudda taluk (24.11%), Bagalkot taluk (22.11%) and the lowest average per cent disease incidence (19.91%) was recorded in Jamkhandi taluk (Table 1 and 2).

The variation in disease incidence in different areas might be because of the prevalence of different climatic conditions favouring multiplication and migration of vector responsible for the spread of the disease. The characteristic symptoms observed in the field were conversion of floral parts into green leaf like structure, stunted growth, reduction of internodal length, reduction of leaf size and no seed production from the affected parts. The main reason for the increased incidence of disease in Vijayapur and Bagalkot districts is may be due to extensive and continuous cultivation of the same popular cultivars like DS-5 and DSS-9 year after year and the epidemiological factors favouring the spread of the leaf hoppers.

Sridhar and Patil (2013) during *kharif* 2009 conducted a survey in Dharwad, Haveri, Gadag, Raichur and Gulbarga

Table 1. Survey for the incidence of sesamumphyllody in northern Karnataka

| District | Taluk | Village | Variety | Age of the crop (days) | Stage of the crop | Cropping pattern | Acreage | Disease incidence (%) |
|---|---|---|---|---|---|---|---|---|
| Bagalkote | Badami | Guddadamallapura | DS-5 | 50 days | Flowering | Sole crop | 2.00 | 34.50 |
| | | Hosur | DSS-9 | 65 days | Flowering and podding | Sole crop | 1.00 | 42.00 |
| | | Narasapura | DS-5 | 60 days | Flowering and podding | Intercrop | 2.00 | 24.75 |
| | | Nasagunni | DSS-9 | 55 days | Flowering | Sole crop | 1.50 | 33.50 |
| | | Hulageri | DSS-9 | 45 days | Flowering | Intercrop | 2.00 | 27.25 |
| | | Muttalageri | DS-5 | 50 days | Flowering | Sole crop | 1.00 | 13.00 |
| | Bagalkote | Kirasura | DSS-9 | 45 days | Flowering | Sole crop | 1.25 | 32.33 |
| | | Devalapura | DS-5 | 60 days | Flowering and podding | Intercrop | 0.75 | 16.50 |
| | | Ingalagi | DSS-9 | 55 days | Flowering | Sole crop | 1.50 | 28.00 |
| | | Chitaginakoppa | DS-5 | 60 days | Flowering | Intercrop | 0.50 | 12.24 |
| | | Nayanegali | DS-5 | 50 days | Flowering | Sole crop | 2.00 | 29.60 |
| | | Mannikatti | DSS-9 | 45 days | Flowering | Sole crop | 1.00 | 14.00 |
| | Guledagudda | Lingapura | DS-5 | 60 days | Flowering and podding | Intercrop | 1.00 | 18.33 |
| | | Hansanura | DSS-9 | 55 days | Flowering | Sole crop | 3.00 | 42.50 |
| | | Togunasi | DS-5 | 50 days | Flowering | Intercrop | 0.75 | 11.50 |
| | Hungund | Aihole | DS-5 | 60 days | Flowering and podding | Sole crop | 0.50 | 8.00 |
| | | Nagura | DSS-9 | 55 days | Flowering | Sole crop | 1.00 | 22.45 |
| | | Chittavadagi | DS-5 | 60 days | Flowering and podding | Sole crop | 1.50 | 31.33 |
| | | Balakundi | DSS-9 | 60 days | Flowering and podding | Intercrop | 1.00 | 34.60 |

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|---|---|---|---|---|---|---|---|---|
| Bagalkote | Hungund | Chamalapura | DSS-9 | 55 days | Flowering | Sole crop | 3.00 | 42.00 |
| | | Chikkakodagali | DS-5 | 50 days | Flowering | Intercrop | 0.75 | 23.50 |
| | | Chikkotageri | DSS-9 | 55 days | Flowering | Sole crop | 2.50 | 44.00 |
| | | Dammura | DS-5 | 50 days | Flowering | Sole crop | 2.00 | 36.25 |
| | | Hireotageri | DSS-9 | 60 days | Flowering and podding | Intercrop | 1.00 | 28.00 |
| | | Jambaladinni | DS-5 | 55 days | Flowering | Sole crop | 2.25 | 39.77 |
| | | Kandagalla | DS-5 | 50 days | Flowering | Intercrop | 0.50 | 18.00 |
| | | Ilkal | DSS-9 | 70 days | Flowering and podding | Sole crop | 2.50 | 50.45 |
| | | Krushnapura | DS-5 | 55 days | Flowering | Sole crop | 1.75 | 48.00 |
| | | Maratageri | DSS-9 | 50 days | Flowering | Sole crop | 1.50 | 39.33 |
| | | Sankalapura | DS-5 | 50 days | Flowering | Intercrop | 1.00 | 27.64 |
| | | Tallikeri | DS-5 | 60 days | Flowering | Sole crop | 1.00 | 30.50 |
| | | Vadageri | DS-5 | 55 days | Flowering | Intercrop | 0.50 | 20.00 |
| | Jamakhandi | Savalagi | DS-5 | 60 days | Flowering and podding | Sole crop | 0.75 | 25.40 |
| | | Kajibeelagi | DSS-9 | 60 days | Flowering and podding | Intercrop | 0.25 | 14.66 |
| | | Hosur | DS-5 | 55 days | Flowering | Sole crop | 1.50 | 26.33 |
| | | Kadakol | DS-5 | 50 days | Flowering | Intercrop | 0.75 | 13.25 |
| | Mudhol | Akkimaradi | DS-5 | 55 days | Flowering | Sole crop | 1.00 | 16.00 |
| | | Alagundi | DS-5 | 60 days | Flowering | Sole crop | 2.00 | 36.45 |
| | | Belagali | DSS-9 | 55 days | Flowering | Sole crop | 1.50 | 29.62 |
| Vijayapur | Basavana Bagewadi | Nagura | DS-5 | 60 days | Flowering | Intercrop | 1.00 | 25.65 |
| Vijayapur | Basavana Bagewadi | Managuli | DS-5 | 50 days | Flowering | Sole crop | 1.50 | 32.34 |
| | | Kanakala | DSS-9 | 45 days | Flowering | Sole crop | 0.50 | 20.50 |
| | | Yaranala | DSS-9 | 60 days | Flowering and podding | Intercrop | 0.50 | 18.00 |
| | Vijayapur | Kaggoda | DSS-9 | 55 days | Flowering | Sole crop | 0.75 | 24.33 |
| | | Katakanalli | DSS-9 | 50 days | Flowering | Intercrop | 1.25 | 35.50 |
| | | Bommanalli | DSS-9 | 55 days | Flowering | Sole crop | 1.00 | 29.00 |
| | | Hitnalli | DSS-9 | 65 days | Flowering and podding | Sole crop | 0.50 | 18.25 |
| | | Kavalagi | DSS-9 | 50 days | Flowering | Intercrop | 0.25 | 12.00 |
| | | Jumnal | DSS-9 | 50 days | Flowering | Sole crop | 1.00 | 25.75 |
| | Devara Hipparagi | Byravaadagi | DSS-9 | 45 days | Flowering | Intercrop | 0.50 | 14.00 |
| | | Mannura | DSS-9 | 55 days | Flowering | Sole crop | 1.00 | 22.28 |
| | | Vandala | DSS-9 | 50 days | Flowering | Intercrop | 1.00 | 27.45 |
| | Indi | Jhalaki | DS-5 | 55 days | Flowering | Intercrop | 0.75 | 14.20 |
| | | Masali B K | DS-5 | 55 days | Flowering | Sole crop | 1.50 | 15.25 |
| | | Choragi | DSS-9 | 55 days | Flowering | Sole crop | 0.50 | 13.00 |
| | Indi | Lachyana | DSS-9 | 65 days | Flowering and podding | Intercrop | 1.00 | 20.50 |
| | | Tadavalaga | DS-5 | 55 days | Flowering | Sole crop | 1.00 | 18.33 |
| | Muddebihal | Hullura | DS-5 | 55 days | Flowering | Sole crop | 0.50 | 25.42 |
| | | Taranala | DS-5 | 50 days | Flowering | Intercrop | 0.25 | 30.40 |
| | | Abbihala | DS-5 | 50 days | Flowering | Sole crop | 1.50 | 26.33 |
| | | Nalatavada | DSS-9 | 45 days | Flowering | Intercrop | 0.75 | 29.28 |
| | | Chavanbhavi | DSS-9 | 60 days | Flowering and podding | Intercrop | 1.25 | 27.00 |
| | | Rakkasagi | DSS-9 | 55 days | Flowering | Sole crop | 2.00 | 36.25 |
| | | Alura | DSS-9 | 50 days | Flowering | Intercrop | 0.75 | 16.00 |
| | Talikoti | Lingadalli | DS-5 | 50 days | Flowering | Sole crop | 1.25 | 35.50 |
| | | Hadaginala | DSS-9 | 55 days | Flowering | Intercrop | 1.00 | 29.00 |
| | | Maileshvara | DSS-9 | 60 days | Flowering and podding | Intercrop | 0.50 | 18.00 |
| | | Maskanala | DSS-9 | 55 days | Flowering | Sole crop | 0.50 | 10.52 |
| | | Minajagi | DS-5 | 50 days | Flowering | Intercrop | 1.00 | 28.00 |
| | | Aski | DSS-9 | 50 days | Flowering | Sole crop | 1.50 | 25.33 |
| | | Bavura | DSS-9 | 45 days | Flowering | Intercrop | 0.50 | 18.25 |
| | | Bilebhavi | DS-5 | 60 days | Flowering and podding | Intercrop | 0.75 | 20.66 |

Table 2. Average per cent incidence of sesamum phyllody disease in Vijayapur and Bagalkot districts of northern Karnataka

| Districts | Taluks | Average disease incidence of taluk (%) | Average disease incidence of districts (%) |
|---|---|---|---|
| Vijayapur | Talikoti | 23.15 | 22.73 |
| | Vijayapur | 24.13 | |
| | Muddebihal | 27.54 | |
| | Indi | 16.25 | |
| | Devara Hipparagi | 21.24 | |
| | Basavana Bagewadi | 24.12 | |
| Bagalkot | Bagalkot | 22.11 | 25.77 |
| | Badami | 29.16 | |
| | Guledagudda | 24.11 | |
| | Hungund | 31.98 | |
| | Mudhol | 27.35 | |
| | Jamkhandi | 19.91 | |

Table 3. Abundance of different leafhopper species in sesamum ecosystem during different standard meteorological weeks

| Month (year) | SMWs | *Hishimonus phycitis* distant | Mean | *Orosius albicinctus* distant | Mean | *Amrasca biguttula biguttula* ishida | Mean |
|---|---|---|---|---|---|---|---|
| August | 30 | 0.40 | 0.95 | 3.00 | 13.50 | 2.00 | 9.60 |
| 2021 | 31 | 1.00 | | 7.80 | | 11.80 | |
| | 32 | 0.80 | | 6.00 | | 6.80 | |
| | 33 | 1.60 | | 37.20 | | 17.80 | |
| September | 34 | 2.20 | 4.15 | 17.40 | 33.75 | 9.20 | 14.25 |
| 2021 | 35 | 2.20 | | 22.80 | | 11.60 | |
| | 36 | 4.80 | | 60.40 | | 15.00 | |
| | 37 | 7.40 | | 34.40 | | 21.20 | |
| October | 38 | 7.40 | 11.30 | 75.20 | 46.10 | 11.00 | 11.10 |
| 2021 | 39 | 14.60 | | 43.60 | | 13.00 | |
| | 40 | 12.80 | | 38.60 | | 10.40 | |
| | 41 | 10.40 | | 27.00 | | 10.00 | |

districts. Phyllody disease incidence ranged from 2.62 to 55.70 per cent. Raichur had the highest average disease incidence (52.39%), followed by Kalaburgi (50.55%), Gadag (39.55%) and Haveri (16.57%). Dharwad had the lowest average percentage disease incidence (3.46%). Devanna *et al.* (2020) conducted a survey in the sesame fields of Karnataka during July-September 2010 in *kharif* and recorded an incidence of 32.14 per cent.

Three different leaf hopper species were observed during the research period *viz., Orosius albicinctus* Distant, *Amrasca biguttula biguttula* Ishida and *Hishimonus phycitis* Distant. Relative abundance was measured by considering the population of different individual leaf hopper species with the total population of leaf hoppers. Among three species of leaf hopper, *Orosius albicinctus* Distant was the most abundant species found throughout the experimental period with relative abundance of 64.92 per cent. Second most abundant species was *Amrasca biguttula biguttula* Ishida with relative abundance of 23.73 per cent and *Hishimonus phycitis* Distant was least abundant species with relative abundance of 11.33 per cent. Tabulation of relative abundance of three leaf hopper species is presented in Table 3 and 4.

An attempt was made to correlate the most abundant species *i.e., Orosius albicinctus* Distant population with the weather parameters like maximum and minimum air temperature, morning and evening relative humidity, sunshine hours and rainfall during the study period. Results pertaining to population dynamics of leaf hopper were tabulated and presented in Table 5, Table 6 and Fig. 1.

Table 4. Measurement of relative abundance of different leaf hopper species on sesamum

| Leaf hopper species | RA= $n_i/N$ | Relative abundance (%) |
|---|---|---|
| *Hishimonus phycitis* Distant | 0.113337 | 11.33 |
| *Orosius albicinctus* Distant | 0.64927 | 64.92 |
| *Amrasca biguttula biguttula* Ishida | 0.23738 | 23.73 |

Mean population of *Orosius albicinctus* Distant was calculated in different standard meteorological weeks. The population of leaf hopper *Orosius albicinctus* Distant was highest during 38$^{th}$ and 36$^{th}$ standard meteorological weeks (SMWs) with the mean value of 75.20 and 60.40, respectively.

The leaf hopper *Orosius albicinctus* Distant population varied from month to month at different crop stages. Leaf hopper *O. albicinctus* Distant population build up showed strong significant positive correlation with rainfall and positive correlation with morning relative humidity and evening relative humidity. There was non significant positive correlation with sunshine duration and non-significant negative correlation with maximum temperature and minimum temperature.

Similar findings were reported by Kumar *et al.* (2009) who revealed that the peak infestation of vector *O. albicinctus* Distant (leaf hopper) was observed in 36$^{th}$ meteorological week

Table 5. Population of *O. albicinctus* Distant during different standard meteorological weeks (SMWs) along with weather parameters

| Standard Meteorological Week No | Air Temperature max. ($^0$C) | Air Temperature min. ($^0$C) | Relative humidity I (%) | Relative humidity II (%) | Sunshine duration (h) | Rainfall (mm) | Mean population of *orosius albicinctus* distant |
|---|---|---|---|---|---|---|---|
| 30 | 30.4 | 21.3 | 90 | 59 | 6.1 | 5.0 | 3.00 |
| 31 | 29.7 | 21.7 | 88 | 62 | 2.6 | 3.0 | 7.80 |
| 32 | 31.8 | 21.6 | 87 | 54 | 6.5 | 1.4 | 6.00 |
| 33 | 29.6 | 21.1 | 90 | 63 | 3.8 | 23.0 | 37.20 |
| 34 | 31.6 | 21.4 | 91 | 54 | 5.5 | 16.5 | 17.40 |
| 35 | 29.6 | 21.6 | 89 | 63 | 1.8 | 24.2 | 22.80 |
| 36 | 28.9 | 21.3 | 91 | 70 | 3.3 | 49.3 | 60.40 |
| 37 | 29.8 | 21.4 | 91 | 66 | 6.0 | 8.0 | 34.40 |
| 38 | 31.3 | 21.1 | 91 | 65 | 6.5 | 72.0 | 75.20 |
| 39 | 28.5 | 21.2 | 91 | 68 | 4.1 | 32.4 | 43.60 |
| 40 | 31.7 | 21.4 | 91 | 58 | 8.9 | 25.8 | 38.60 |
| 41 | 31.4 | 20.6 | 92 | 51 | 6.9 | 7.4 | 27.00 |

Table 6. Correlation of *Orosius albicinctus* distant population with major environmental factors during *Kharif*- 2021

| | Air temperature | | Relative humidity | | Sunshine | Rainfall |
|---|---|---|---|---|---|---|
| | Max. (°C) | Min. (°C) | I (%) | II (%) | (h) | (mm) |
| *Orosius albicinctus* Distant population | -0.206$^{NS}$ | -0.396$^{NS}$ | 0.579$^{*}$ | 0.599$^{*}$ | 0.060$^{NS}$ | 0. 919$^{**}$ |

Note: NS: Non-significant correlation, *: Significant correlation, **: Strong significant correlation

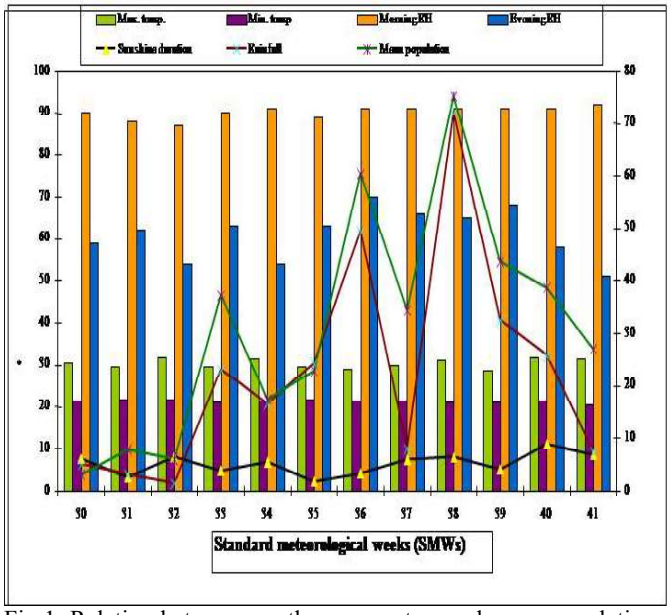


Fig 1. Relation between weather parameters and mean population of *Orosius albicinctus* at different SMWs

therefore crop sown in 35-36$^{th}$ meteorological week showed highest phyllody disease. These results were corroborated with Yadav *et al.* (2021) who reported that, the maximum population of leaf hopper 7.71/leaf was recorded at 36$^{th}$ standard meteorological week. Minimum temperature, relative humidity and rainfall had positive correlation with the leaf hopper population and maximum temperature had non- significant negative correlation with leaf hopper.

## Conclusion

The average disease incidence of sesamum phyllody ranged from 8.00 to 50.45 per cent in Vijayapur and Bagalkot districts. Among them, Bagalkot recorded highest mean disease incidence of 25.77 per cent followed by Vijayapur with mean disease incidence of 22.73 per cent. In Vijayapur district, the survey was conducted in six taluks. Amongst the taluks, highest average per cent disease incidence was observed in Muddebihal taluk (27.54%) and least incidence was recorded in Indi taluk (16.25%). Among villages, highest per cent disease incidence of 36.25 per cent was recorded in Rakkasagi village and lowest per cent disease incidence of 10.52 was observed in Maskanala village. In Bagalkote district, the highest average per cent disease incidence of 31.98 per cent was observed in Hungund taluk and among villages in Bagalkot district, the highest incidence was observed in Ilkal village of Hungund taluk with 50.45 per cent disease incidence and lowest disease incidence of 8.00 per cent was recorded in Aihole village of Hungund taluk.

*O. albicinctus* Distant was identified as the major leaf hopper species which was responsible for the transmission of sesamum phyllody disease during the course of research. Mean population of *O. albicinctus* Distant was calculated in different standard meteorological weeks. The leaf hopper population varied from month to month at different crop stages. The population was less during the vegetative stage but gradually increased during the flowering and capsule formation stage. The population of leaf hopper *O. albicinctus* Distant was highest during 38$^{th}$ and 36$^{th}$ standard meteorological weeks (SMWs).

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