Documentation of insect-pests in Gerbera (*Gerbera jamesonii* H. Bolus) in Kerala and their management

Abstract:

A survey was conducted across three districts of Kerala, namely Thiruvananthapuram, Thrissur, and Wayanad, to document the insect pests and natural enemies associated with gerbera (*Gerbera jamesonii* H. Bolus) cultivars. The major pests identified were aphids (*Macrosiphum euphorbiae* Thomas), scales (*Icerya* sp.), thrips (*Scirtothrips dorsalis* Hood and *Haplothrips* sp.), and mites (*Tetranychus* sp.). Natural enemies recorded included spiders such as *Plexippus paykulli* (Audouin), *Theridion* sp., *Oxyopes birmanicus* (Thorell), and *Ptocassius* sp. Further, the efficacy of various treatments was evaluated under polyhouse conditions at the College of Agriculture, Vellayani, Thiruvananthapuram, for the management of *Tetranychus* sp. and *S. dorsalis* in gerbera. The results demonstrated that spiromesifen 22.9% SC, applied at 96 g a.i./ha, was highly effective in managing mites and thrips, offering a promising solution for pest management in gerbera cultivation.

Key words: Gerbera, survey, spiders, mites, thrips, fipronil + imidacloprid, thiamethoxam and spiromesifen.

Introduction

Gerbera (*Gerbera jamesonii* H. Bolus ex Hooker F.), commonly known as the African daisy, is a highly valued commercial cut flower that holds significant importance in international flower markets due to its vibrant colours and wide-ranging appeal. In India, gerbera cultivation covers approximately 1.15 thousand hectares with an annual production of 25.55 thousand metric tons (Indiastat, 2020). However, the profitable cultivation of gerbera is often hindered by various factors, with pest incidence being one of the most critical contributors to yield losses. Gerbera is susceptible to a wide range of insect and non-insect pests, including mites, nematodes, snails, and rodents, which cause damage at different growth stages, from seedling establishment to harvest. Among these, the major insect pests infesting gerbera include whiteflies (*Bemisia tabaci* Gennadius and *Trialeurodes vaporariorum* Westwood), onion thrips (*Thrips tabaci* Lindeman), western flower thrips (*Frankliniella occidentalis* Pergande), aphids (*Myzus persicae* Sulzer), American serpentine leaf miner (*Liriomyza trifolii* Bergess), two-spotted spider mite (*Tetranychus urticae* Koch), yellow mite (*Polyphagotarsonemus latus* Banks), and foliage-feeding armyworm (*Spodoptera litura* Fabricius) (Rani and Mohan, 1997). These pests primarily target the leaves and flower parts, leading to significant reductions in plant vigour, aesthetic quality, and marketable yield. Sucking pests, such as whiteflies, thrips, and aphids, are particularly damaging due to their direct feeding injuries and their role as vectors for viral diseases like Tomato Spotted Wilt Virus (TSWV) and Chrysanthemum Stem Necrosis Virus (CSNV), which further reduce flower quality. Additionally, pests like *Tetranychus urticae* and *Polyphagotarsonemus latus* cause substantial damage to the foliage, reducing the plant’s photosynthetic efficiency and overall growth. Previous studies, such as those by Ravikumar et al. (2017) and Kumar et al. (2019), have emphasized the economic impact of these pests, particularly under protected cultivation conditions, where the warm and humid microclimate often favours their proliferation. Shukla et al. (2020) reported that foliage-feeding armyworms such as *Spodoptera litura* can cause significant damage in open field conditions, further compounding losses in gerbera production systems. Although the pest complex of gerbera has been well-studied in several regions of India, there is limited information on pest incidence and infestation dynamics in Kerala, where the unique climatic conditions and year-round cultivation practices create an ideal environment for pest outbreaks. Sucking pests, in particular, are reported to be the most prominent problem in gerbera cultivation in this region. The lack of region-specific pest management strategies highlights the need for detailed investigations into pest incidence and the development of effective control measures.

In light of above challenges, the present study was conducted to examine the pest complex associated with gerbera grown under protected cultivation in Kerala. The study also aims to formulate suitable management strategies to mitigate the impact of pests and improve the profitability of gerbera cultivation in the region.

Material and methods

Study area

The documentation of pests and natural enemies of gerbera was conducted in polyhouse located in Thiruvananthapuram, Thrissur, and Wayanad districts of Kerala during the month of Feb, 2020. A separate experiment to study the management of pests in gerbera under polyhouse conditions was carried out at the College of Agriculture, Vellayani, Thiruvananthapuram, during the same period.

Plant material and trail management

The susceptible check “Sona” variety of gerbera is used in the present investigation. Plants were cultivated in polybags under polyhouse conditions. The experiment was laid out in a completely randomized design (CRD) with six treatments, each replicated four times. The treatments comprised of *Lecanicillium lecanii* @ 20g L^{-1}, fish jaggery 0.5% @ 5 mL L^{-1}, fipronil 40%+ imidacloprid 40%WG @ 0.40 g L^{-1}, thiamethoxam 25%WG 0.20 g L^{-1}, spiromesifen 22.9%SC @ 1 mL L^{-1} and untreated control.

Data Collection

Thrips and mites were the primary pests observed on experimental plants during the study period. The population of thrips and mites on the leaves was recorded before treatment at 1, 3, 5, 7, and 15 days after treatment. Three leaves were randomly selected from the top, middle, and bottom portions of each plant, and the mean number of pests was counted and recorded following the methodology described by Thamilarasi (2014). Additionally, the percentage infestation of thrips and mites per plant was documented before treatment and at 15 days post-treatment.

Statistical Analysis

The collected data were analysed using SAS software. Suitable data transformations were applied, and significant results were interpreted based on critical differences.

Results

Results on documentation of sucking pests and their infestation on gerbera under poly houses of Thiruvananthapuram, Thrissur and Wayanad districts of Kerala are presented in Table 1. The pests newly identified from gerbera were aphid, *Macrosiphum euphorbia* (Thomas), scales, *Icerya* sp., and thrips, (*Scirtothrips dorsalis* and *Haplothrips* sp.).Natural enemies *viz.*, spiders recorded and identified were *Plexippus paykulli* (Audouin), *Theridion* sp., *Oxyopes birmanicus* (Thorell) and *Ptocassius* sp. (Table 1).

The present study could document only the sucking pests from both leaves and flowers, whereas various other studies reported different group pests *viz.*, sucking pests, leaf feeders, foliage feeders etc. from gerbera plants.

Population of mites, *Tetranychus* sp

The results of the study on the mite population in gerbera plants treated with various treatments showed no significant differences in mite populations before treatment and one day after treatment. However, by the third day after treatment, a significantly lower population of mites was observed in plants treated with spiromesifen 22.9% SC @ 1 mL L^{-1} (69.25), which was on par with fish jaggery 0.5% @ 5 mL L^{-1} (91.75). These were followed by fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} (101.00) and thiamethoxam 25% WG @ 0.20 g L^{-1} (126.50), both of which were statistically on par. The treatment with *Lecanicillium lecanii* @ 20 g L^{-1} resulted in a higher mite population (146.50) compared to other treatments. After five days, spiromesifen 22.9% SC @ 1 mL L^{-1} maintained the lowest mite population (12.75), while fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} (50.75), fish jaggery 0.5% @ 5 mL L^{-1} (73.25), and thiamethoxam 25% WG @ 0.20 g L^{-1} (61.25) had comparable results. In contrast, *L. lecanii* @ 20 g L^{-1} recorded a significantly higher population of mites (103.50) (Table.2).

Similar trends were observed on the seventh and fifteenth days after treatment. By the seventh day, spiromesifen 22.9% SC @ 1 mL L^{-1} recorded the lowest mite population (3.25), which was significantly different from all other treatments. Fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} (17.50) and thiamethoxam 25% WG @ 0.20 g L^{-1} (21.25) had comparable mite populations, while *L. lecanii* @ 20 g L^{-1} (63.25) and fish jaggery 0.5% @ 5 mL L^{-1} (48.00) were statistically on par. Control plants consistently recorded the highest mite population (179.25). By the fifteenth day, spiromesifen 22.9% SC @ 1 mL L^{-1} demonstrated a 99.61% reduction in the mite population, achieving the most effective control. The mite populations in plants treated with thiamethoxam 25% WG @ 0.20 g L^{-1} (10.50), *L. lecanii* @ 20 g L^{-1} (13.00), fish jaggery 0.5% @ 5 mL L^{-1} (13.25), and fipronil 40% + imidacloprid

40% WG @ 0.40 g L^{-1} (14.25) were significantly on par (Table.2). These results highlight the superior efficacy of spiromesifen 22.9% SC in controlling mite populations in gerbera plants.

Leaf infestation (%) by mites, *Tetranychus* sp

The results on leaf infestation caused by mites in gerbera plants showed no significant differences before treatment. After 15 days, spiromesifen 22.9% SC @ 1 mL L^{-1} treated plants exhibited significantly lower leaf infestation (12.77%). Plants treated with *L. lecanii* @ 20 g L^{-1} (72.08%), fish jaggery 0.5% @ 5 mL L^{-1} (66.25%), and fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} (46.42%) showed similar infestation levels. Thiamethoxam 25% WG @ 0.20 g L^{-1} treated plants had a 38.65% infestation (Table.3).

Population of thrips, *S.dorsalis*

The results on the population of thrips in gerbera plants after different treatments showed no significant difference before treatment and one day after treatment. After three days, fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} treated plants recorded the lowest thrips population (10.25), followed by spiromesifen 22.9% SC @ 1 mL L^{-1} (11.56) and thiamethoxam 25% WG @ 0.20 g L^{-1} (12.00), all of which were significantly different from fish jaggery 0.5% @ 5 mL L^{-1} (15.25) and *L. lecanii* @ 20 g L^{-1} (15.50). After five days, fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} treated plants exhibited the lowest population of thrips (3.50), followed by spiromesifen 22.9% SC @ 1 mL L^{-1} (3.50) and thiamethoxam 25% WG @ 0.20 g L^{-1} (5.93), which were statistically on par. *L. lecanii* @ 20 g L^{-1} treated plants had 8.75 thrips, and fish jaggery 0.5% @ 5 mL L^{-1} had the highest population of thrips (9.50), which was significantly different from the control (23.25) (Table.4).

After seven days, fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} treated plants showed no thrips population. The thrips populations in spiromesifen 22.9% SC @ 1 mL L^{-1} (0.25) and thiamethoxam 25% WG @ 0.20 g L^{-1} (1.00) were statistically on par. *L. lecanii* @ 20 g L^{-1} and fish jaggery 0.5% @ 5 mL L^{-1} treated plants recorded similar populations (3.25 each). After 15 days, fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} treated plants recorded the lowest thrips population (1.50), followed by spiromesifen 22.9% SC @ 1 mL L^{-1} (1.75), thiamethoxam 25% WG @ 0.20 g L^{-1} (2.00), and *L. lecanii* @ 20 g L^{-1} (3.75), which were statistically on par. Fish jaggery 0.5% @ 5 mL L^{-1} treated plants had a higher thrips population (5.25) (Table.4).

Leaf infestation (%) by thrips, *S.dorsalis*

The results on leaf infestation by thrips in gerbera plants showed no significant difference before treatment. After 15 days, spiromesifen 22.9% SC @ 1 mL L^{-1} treated plants had significantly lower leaf infestation (18.68%), followed by fipronil 40% + imidacloprid 40% WG @ 0.40 g L^{-1} (20.71%) and thiamethoxam 25% WG @ 0.20 g L^{-1} (23.68%), which were statistically on par. Fish jaggery 0.5% @ 5 mL L^{-1} (44.72%) and *L. lecanii* @ 20 g L^{-1} (51.45%) treated plants exhibited significantly higher infestations and were statistically on par (Table.5).

Discussion

This study was conducted to identify the pest complex associated with gerbera under protected cultivation in Kerala and to develop effective management strategies to reduce pest damage and improve the profitability of gerbera cultivation. Gerbera, being a high-value ornamental crop, is highly susceptible to a variety of pests that significantly affect its quality and yield. The findings of this study are consistent with earlier research, which identified several major pests infesting gerbera, such as the American serpentine leaf miner (*Liriomyza trifolii*), whitefly (*Bemisia tabaci*), aphid (*Myzus persicae*), thrips (*Thrips palmi*), and two-spotted spider mite (*Tetranychus urticae*) as key pests (Dnyaneshwar, 2003; Bhosale, 2007). Similarly, Shah (2014) and others reported extensive damage caused by these pests in gerbera grown under polyhouse conditions.

In addition to confirming the prevalence of previously documented pests, the present study identified new pest species infesting gerbera, including the aphid (*Macrosiphum euphorbia*), scales (*Icerya* sp.), and thrips (*Scirtothrips dorsalis* and *Haplothrips* sp.). Moreover, natural enemies such as spiders, including *Plexippus paykulli* (Audouin), *Theridion* sp., *Oxyopes birmanicus* (Thorell), and *Ptocassius* sp., were recorded, suggesting their potential role in biological control within the protected cultivation system.

The study evaluated the effectiveness of various treatments for managing these pests, with a focus on strategies that reduce pest populations and mitigate plant damage. Spiromesifen, a novel acaricide/insecticide from the spirocyclic phenyl-substituted tetronic acid chemical class, was found to be highly effective against *T. urticae* mites. Spiromesifen inhibits acetyl-CoA carboxylase, causing a reduction in lipid synthesis and leading to pest mortality (Bielza et al., 2009; Bouabida et al., 2017). When applied at a dose of 1 mL L^{-1}, spiromesifen significantly reduced mite infestation and leaf damage. These findings corroborate the results of Pal and Karmakar (2017), who also reported the effectiveness of spiromesifen in managing mites in gerbera, alongside other acaricides such as fenazaquin, diafenthiuron, and dicofol. This reinforces spiromesifen's suitability as a key component in integrated pest management (IPM) for gerbera.

However, spiromesifen was less effective against thrips compared to mites. While treatments combining spiromesifen with other insecticides, such as thiamethoxam, showed moderate efficacy in controlling thrips, the insecticide mixture of fipronil 40% + imidacloprid 40% WG at 0.40 g L^{-1} emerged as the most effective treatment for managing thrips. Fipronil acts by blocking GABA-gated chloride channels, causing hyper-excitation of the nervous system and pest death (Zhao et al., 2005). Imidacloprid, a systemic insecticide, enhances this efficacy by targeting acetylcholine receptors in the pest's nervous system, leading to paralysis and death (Giraddi et al., 2017). This dual mode of action makes the combination particularly effective against sucking pests like thrips, which are difficult to manage with single insecticides.

These findings align with those of Viswanathan (2019), who reported the superior efficacy of fipronil + imidacloprid in controlling whiteflies and other pests in chilli crops under similar conditions in Kerala. The excellent performance of this mixture against thrips in gerbera confirms its potential as a valuable pest management tool in ornamental crop cultivation.

The findings from this study contribute to the existing knowledge on pest management in gerbera and provide valuable insights into the efficacy of specific treatments against key pests. A combination of spiromesifen for mite control and fipronil + imidacloprid for thrips management appears to be an effective strategy for reducing pest populations and minimizing economic losses in gerbera cultivation.

The study also emphasizes the need for integrating these chemical treatments into broader IPM strategies. Factors such as environmental sustainability, the potential for pest resistance, and the cost-effectiveness of treatments must be considered to ensure long-term success. Additionally, the identification of natural enemies highlights the potential for augmentative biological control measures to complement chemical treatments and enhance pest management outcomes in gerbera cultivation.

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Table 1. Pests and natural enemies documented from gerbera

Sl. No	Common name	Scientific name	Parts of plant from where pest collected	Place of collection
1	Thrips	*Scirtothrips dorsalis* Hood	leaves	Thiruvananthapuram, Wayanad
		Haplothrips sp.	Flower buds and flowers	
2	Scales	*Icerya* sp.	leaves	Thrissur
3	Aphids	*Macrosiphum euphorbia* Thomas	leaves	Wayanad
4	Spiders	*Plexippus paykulli* (male) Audouin, *Theridion* sp.	leaves	Thrissur
		Oxyopes birmanicus Thorell, *Ptocassius* sp.	leaves	Thiruvananthapuram
		Plexippus paykulli (female) Audouin	leaves	Wayanad

Table 2. Population of mites, *Tetranychus* sp. in gerbera after the application of different treatments

Treatments	Dosage (g or mL L^{-1})	* Number of mites per plant (DAT)					
		Precount	1	3	5	7	15
Lecanicillium lecanii	20.00	168.25 (12.97)	166.75 (12.91)	146.50 (12.10)^{ab}	103.50 (10.17)^{b}	63.25 (7.95)^{b}	13 (3.60)^{b}
Fish jaggery 0.5%	5.00	161.25 (12.69)	158.50 (12.58)	91.75 (9.57)^{bc}	73.25 (8.55)^{bc}	48.00 (6.92)^{bc}	13.25 (3.64)^{b}
Fipronil 40%+Imidacloprid 40%WG (175+175g a.i ha $^{-1}$)	0.40	179.75 (13.40)	179.00 (13.37)	101.00 (10.04)^{abc}	50.75 (7.12)^{c}	17.5 (4.18)^{d}	14.25 (3.77)^{b}
Thiamethoxam 25%WG (50g a.i ha $^{-1}$)	0.20	179.00 (13.37)	177.75 (13.33)	126.50 (11.24)^{abc}	61.25 (7.82)^{bc}	21.25 (4.60)^{cd}	10.50 (3.24)^{b}
Spiromesifen 22.9%SC (96g a.i ha $^{-1}$)	1.00	195.25 (13.97)	191.50 (13.83)	69.25 (8.32)^{c}	12.75 (3.57)^{d}	3.25 (1.80)^{e}	0.75 (0.86)^{c}

Control	-	151.25 (12.29)	152.00 (12.32)	162.75 (12.75)^{a}	167.75 (12.95)^{a}	179.25 (13.38)^{a}	182.75 (13.51)^{a}
CD (0.05)		(NS)	(NS)	(2.99)	(2.75)	(2.59)	(0.99)

*Mean of 4 replications, DAT-Days after treatment, Figures in parentheses are $\sqrt{x+1}$ transformed values

Table 3. Leaf infestation (%) of mites, *Tetranychus* sp. in gerbera after the application of different treatments

Treatments	Dosage (g or mL L^{-1})	Infestation in leaves (%)*	
		Pre count	15 DAT
Lecanicillium lecanii	20.00	80.20(63.57)	72.08(58.10)^{b}
Fish jaggery 0.5%	5.00	69.16(56.26)	66.25(54.48)^{b}
Fipronil 40%+Imidacloprid 40%WG (175+175g a.i ha $^{-1}$)	0.40	78.27(62.21)	46.42(42.94)^{bc}
Thiamethoxam 25%WG (50g a.i ha $^{-1}$)	0.20	87.86(69.60)	38.65(38.43)^{c}
Spiromesifen 22.9%SC (96g a.i ha $^{-1}$)	1.00	87.91(69.65)	12.77(20.93)^{d}
Control		85.71(67.78)	100(89.41)^{a}
CD (0.05)		(NS)	(19.77)

*Mean percent of 4 replications comprising 4 plants each, DAT-Days after treatment, Figures in parentheses are arc sin transformed values

Table 4. Population of thrips, *Scirtothrips dorsalis* in gerbera after the application of different treatments

Treatments	Dosage (g or mL L^{-1})	* Number of thrips per plant (DAT)					
		Precount	1	3	5	7	15
Lecanicillium lecanii	20.00	19.00 (4.35)	18.25 (4.27)	15.50 (3.93)^{b}	8.75 (2.95)^{bc}	3.25 (1.80)^{b}	3.75 (1.93)^{bc}
Fish jaggery 0.5%	5.00	19.56 (4.42)	18.56 (4.30)	15.25 (3.90)^{b}	9.50 (3.08)^{b}	3.25 (1.80)^{b}	5.25 (2.29)^{b}
Fipronil 40%+Imidacloprid 40%WG (175+175g a.i ha $^{-1}$)	0.40	20.25 (4.50)	18.75 (4.33)	10.25 (3.20)^{c}	0.50 (0.70)^{e}	(0) (0.70)^{c}	1.50 (1.22)^{c}
Thiamethoxam 25%WG (50g a.i ha $^{-1}$)	0.20	20.18 (4.49)	19.18 (4.37)	12.00 (3.46)^{bc}	5.93 (2.43)^{cd}	1.00 (1.14)^{c}	2.00 (1.41)^{bc}
Spiromesifen 22.9%SC (96g a.i ha $^{-1}$)	1.00	21.37 (4.62)	19.87 (4.45)	11.56 (3.40)^{c}	3.50 (1.87)^{d}	0.25 (0.50)^{c}	1.75 (1.32)^{bc}
Control	-	17.37 (4.16)	18.12 (4.25)	21.62 (4.64)^{a}	23.25 (4.82)^{a}	25.00 (5.00)^{a}	26.75 (5.17)^{a}

CD (0.05)		(NS)	(NS)	(0.49)	(0.57)	(0.62)	(0.95)

*Mean of 4 replications, DAT-Days after treatment, Figures in parentheses are $\sqrt{x+1}$ transformed values

Table 5. Infestation of leaves (%) by thrips, *Scirtothrips dorsalis* in gerbera after the application of different treatments

Treatments	Dosage (g or mL L^{-1})	Infestation in leaves (%)*	
		Pre count	15 DAT
Lecanicillium lecanii	20.00	63.34(52.73)	51.45(45.83)^{b}
Fish jaggery 0.5%	5.00	63.12(52.60)	44.72(41.96)^{b}
Fipronil 40%+Imidacloprid 40%WG (175+175g a.i ha^{-1})	0.40	69.93(57.14)	20.71(27.07)^{c}
Thiamethoxam 25%WG (50g a.i ha^{-1})	0.20	48.55 (44.16)	23.68(29.11)^{c}
Spiromesifen 22.9%SC (96g a.i ha^{-1})	1.00	53.95 (47.26)	18.68(25.60)^{c}
Control		61.51(51.65)	95.00(77.07)^{a}
CD (0.05)		(NS)	(10.56)

*Mean of 4 replications, DAT-Days after treatment, Figures in parentheses are arc sin transformed values