STATUS OF INVASIVE SPECIES OF THRIPS, *THRIPS PARVISPINUS* (KARNY) INFESTING ~~ON~~ CHILLI AND INVESTIGATION STUDIES ON IPDM PACKAGE IN DHARMAPURI DISTRICTS,TAMILNADU~~,INDIA~~

Abstract

Roving survey resultsrevealed that mean population of thrips, mite population and tospovirus incidence wasrecorded to be1.63, 0.68 &2.05 and 1.88,0.74 & 1.57 in Pennagaram and Palacode blocks. In the ~~F~~field experiments,~~results found that~~ mean population in the~~revealed that~~ Module I IPDM module was recorded low thrips population (1.05 n~~N~~os./leaf and 0.64 nos/Sq.m^2 leaves) followed by Module II IPDM (1.11 Nos./leaf and 0.71nos/Sq.m^2 leaves). A virus incidence of 1.0 to 2.0 ~~percent~~% was recorded in t~~T~~reatment 2 module II and int~~T~~reatment 3 f~~F~~armers practices 2.2 to 9.5 ~~percent~~% ~~was observed~~. The per cent~~Percent~~ reduction over control of thrips and mite population is highest in T1 followed by T2 and farmer practice (81.70,80.66 and 56.48~~percent~~%& 79.61,77.38 and 33.12 ~~percent~~%).The ~~percent~~ per cent reduction over control of tospovirus by thrips is the highest in T1 IPDM module followed by IPDM II than farmer practice (100,88.88 and 54.40%). The yield of green chilli and BC ratio were found to be high in IPDM module (22.96 t/ha and 3.02) followed by m~~M~~odule II IPDM (19.14 t/ha and 2.78) followed by farmer's practice (13.88 t/ha and 1.49).

Key words: Chilli, t~~T~~ospovirus incidence, t~~T~~hrips, Mites, IPDM modules

1.INTRODUCTION

Chilli, *Capsicum annuum* L. is one of the important cash crops grown in almost all parts of the country and cultivated in area 1013 hectare, withp~~P~~roduction of 468 t/ha. and yieldof ~~468~~ 461.998 kg/ha in Dharmapuri districts[2]. India is the largest producer, consumer and exporter of chilli in the world and cultivated in an area of 7.32 lakh hectares with a production of 19.88 lakh tonnes in 2020-21.Chilli is considered as one of the most commercial spice crops. ~~and~~It is widely used universal spice that is referred as ~~and its~~wonder spice. Chilli is an indispensable condiment in every household in India which is rich in Vitamin A and C. It is widely used as vegetables, sauce, pickles and curries. ~~Chilli is an important vegetable and condiment crop in India.~~ The hundred grams of edible portion of capsicum provides 24 k cal of energy, 1.3 g of protein, 4.3 g of carbohydrate and 0.3 g of fat [1]. In India, *Thrips parvispinus* (Karny) was first reported on Papaya from Bengaluru in 2015 and considering its potential to acquire pest status, regular monitoring of this pest was carried in other parts of India after its first record [3]. Among 57 species of insect and mite pests on record damaging chilli (Reddy and Puttaswamy 1984), yellow mite (*Polyphagotarsonemus latus* Banks) (Acarina: Tarsonemidae) and thrips (*Scirtothrips dorsalis* Hood) (Thripidae: Thysanoptera) are noted to be of much devastating causing yield loss to the tune of 12 to 90% at national level. In severe infestation, damage caused by thrips and mites are distinctly visible as the former causes typical upward leaf curling, whereas downward leaf curling visible in case of mites [4,8,9. Thrips and Mites are common pests that can cause significant damage to chilli crops. Managing these pests is important to protect the yield and quality of the crop. They infest the chilli crop from seedling stage to reproductive stage. Among different species of mites, yellow mite causes more destruction to the crop. Both adult and nymph stage of thrips and mites causes damage to the chilli crop by sucking the sap from leaves, shoots, buds and fruits. They cause 'leaf curl' symptoms in the affected plants. Mites thrive in hot and dry weather conditions and can cause severe damage during the flowering and fruiting stages of the crop. While thrips infestations are most severe during the early stages of crop growth and the damage can lead to a reduction in the number of fruits per plant and the size of the fruit. Hence, the present study will be taken for research on different IPM modules~~tefor against~~to recordtospovirus transmitted by thrips in Dharmapuri district.

2.MATERIAL AND MATHODS

2.1.Roving survey

Roving survey will be conducted in chilli crop at fortnightly interval during the Rabi season during 2023-2024 in Pennagaram and Palacode block of Dharmapuri District. Four villages will be selected in each block for monitoring the pest population and viral disease from 10 Days after transplanting to harvesting stage of chilli crop. Fixe plot survey was also conducted in Pennagaram block during 2023-2024. Ten plants were selected randomly for recording insects, mite pests from each plot. The leaf curl index (LCI) damage due to thrips and mite pests were also ~~be~~ recorded based on visual observation on 0 - 4 scale. During the survey, the incidence of thrips was counted by using 10X magnifying lens. Later, they were transferred into small sized glass vials (3.5 x 1 cm) containing 70 per cent alcohol. For mites, three half to fully opened top, middle and bottom leaves on ten randomly selected plants were collected in perforated polythene bag of size 16 x 18 cm, and the samples were brought to laboratory and examined under 20X magnification binocular microscope. Total number of mites from each leaf were counted and expressed in terms of number of mites per leaf.

2.2.Field experiments

Field experiments were conducted at farmer's field at Horticultural College and Research Institute, Paiyur,Krishnagiri district and Roving survey and fixed survey was conducted the KVK, Papparapatty, Dharmapuri district during 2023-2024 to study m~~M~~anagement module strategies for Chilli thrips transmitted tospoviruses complex and Mites in Dharmapuri District. The field experiments were laid out in a randomized block design with three treatments including control with seven replications. Observations were recorded on population of thrips from 3 leaves representing top, middle and bottom and expressed as number of thrips per leaf and mite per square cm^2 done from one week after transplanting till the completion of vegetative stage. The per cent reduction over control and yield parameters on green pod yield and BC ratio was computed and the data were statistically analysed and compared.

2.2.1.Treatment details:

T1- IPDM Module I

Seed treatment / Seedling dip with *Bacillus subtilis* @10g/kg of seeds, ~~S~~soil application with Neem cake @ 100kg/acre (Basal), treatment with seeds with imidacloprid 70% WS @ 12 g/kg of seed, 3 row of border crop with sorghum, i~~I~~nstalled with blue sticky traps @ 25-30 per acre for mass trapping, Neem Seed Kernel Extract (NSKE) 5% or Neem oil 3 % 25 DAT, Foliar spary with *Bacillus subtilis @ 0.2%,* Need based insecticide, Tolfenpyrad 15 % EC @ 1 litre/ha. orAcetamprid 20 SP @ 100 g /ha. or Spiromesifin 30 SC 2 ml/l

T2- IPDM Module II

Seedling root dipping with raw cow milk (15%) in combination with *Trichoderma*(4g), incorporation of Vermicompost at 2.5t/ha (basal). and Neem cake at 2.5q/ha. during transplanting, two rows of marigold barrier crop and marigold trap crop (1:16), spray of Garlic extract at 25 DAT, Foliar spray with *Trichoderma @ 0.2%* Need based Azadirachtin 10000 ppm (1 ml/l) + *Lecanicilliumlecanii* at 5 g/l, Chlorfenapyr 10 EC @ 2 ml/lit.

T3- Farmers' practice Module III

T4. Farmer practices~~spray,~~Imidacloprid17.8 SLspray,0.5 ml / litre, Sulpur @ 1g/lit Combination of insecticide - Four rounds of spray at 15 days interval during flowering period.

3.RESULTS AND DISCUSSION

3.1.Roving survey and Field Experiments:

Pennagaram ~~B~~block, thrips and mite population was ranged viz., 0.80 to 3.50 nos/leaves and 0.11 to 1.80 nos/leaves. The mean population of thrips and mite viz., 1.88 nos/leaves and 0.74 nos/leaves in village of Onnappagoundanahalli, Tirumalvadi, Kadamadai and Alamarathampatti at Pennagaram block of Dharmapuri District (Table 2). During the survey, the virus incidence was ranged from 2.0 to 9.5 ~~percent~~%. The highest disease incidence of 9.5% in Alamarathampattivillage and lowest incidence of 2.0 % in Onnappagoundanahallivillage were recorded in Pennagaram block (Table 1).Palacode block, thrips and mite population was ranged viz., 0.20 to 3.00 nos/leaves and 0.00 to 1.70 nos/leaves. The mean population of

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thrips and mite *viz.,* 1.63 nos/leaves and 0.68 nos/leaves in village of Onnappagoundanahalli, Tirumalvadi, Kadamadai and Alamarathampatti at Palacode block of Dharmapuri District. During the survey, the virus incidence was ranged from 3.5 to 9.0 ~~percent~~%. The highest disease incidence of 9.0% in Somanahalli village and lowest incidence of 3.0 % in Elumichanahalli were recorded in Palacode block (Table 1). The present findings are in contradictory to the findings of [6] who reported that thrips populations ranged 0.00 to 7.80 per leaf with up to 92 per cent upward curling. Further, yellow mite counts ranged from 0.00 (at Mugalkod of Belguam) to 20.40 per leaf (at Eklaspur of Raichur) with up to 72 per cent downward leaf curling.

A field experiment conducted on management strategies for Chilli thrips and mites in the Dharmapuri District revealed that the Integrated Pest and Disease Management (IPDM) module (Module I) achieved the highest reduction in thrips and mite infestation, ranging from 0.32 to 2.52 thrips per leaf and 0.34 to 0.68 mites per square meter per leaf. This was followed by Module II, which recorded 0.46 to 3.16 thrips per leaf and 0.58 to 0.96 mites per square meter per leaf. In contrast, the farmer's traditional practice resulted in significantly higher infestations, with 6.46 thrips per leaf and 3.08 mites per square meter of leaf.The average thrips population data further confirmed that Module I of the IPDM recorded the lowest population of both pests (1.05 thrips per leaf and 0.64 mites per square meter), followed by Module II (1.11 thrips per leaf and 0.71 mites per square meter), while the farmer's practice yielded much higher numbers (4.22 thrips per leaf and 2.10 mites per square meter). Consequently, the percentage reduction over the farmer's practice was highest for Module I (75.11% for thrips and 69.52% for mites), followed by Module II (73.70% and 66.19% respectively).In terms of yield and economic efficiency, the IPDM module outperformed the others, producing 22.96 tonnes per hectare with a benefit-cost (BC) ratio of 3.02. This was followed by the insecticide-based module with a yield of 19.14 tonnes per hectare and a BC ratio of 2.78, while the farmer's practice lagged with a yield of 13.88 tonnes per hectare and a BC ratio of 1.49.Previous studies support these findings. For instance, [5] reported that Module IV, which involved mulching, blue sticky traps, and the need-based application of insecticides, was highly effective, yielding 32.22 quintals per hectare, representing an 87.08% increase over untreated control. Similarly, Modules I and III recorded yields of 30.55 and 27.77 quintals per hectare, with an increase of 86.37% and 85.01% over control, respectively. Furthermore, [7] highlighted the effectiveness of several IPM approaches, including timely planting, mulching, balanced nitrogen use, blue sticky traps, biopesticides, microbial pesticides, and insecticides such as Spirotetramat, Tolfenpyrad, and Spinetoram for controlling Thrips parvispinus in chilli-growing regions.~~The field experiment conducted toManagement module strategies for Chilli thrips transmitted tospoviruses complex and Mites in Dharmapuri District revealed that Module I : IPDM module showed maximum per cent reduction in thripsandmitedamage (0.32 -2.52 Nos./leaf and 0.34 to 0.68 per square m2/leaf)followed by Module II (0.46 to 3.16 Nos./leaf and 0.58 to 0.96 per square m2/leaf), whereas farmer's practice recorded maximum of thrips and mites 6.46 numbers/leaf and 3.08 Nos/per square $m^2$of leaf. Similarly the mean thrips population revealed that Module I of IPDM module recorded leastthrips and mites population (1.05 Nos./leaf and 0.64 Nos/per square $m^2$of leaf) followed by Module II IPDM (1.11 Nos./leaf and 0.71 Nos/per square $m^2$of leaf) and Farmer's practice (4.22 Nos./leaf and 2.10 Nos/per square $m^2$of leaf) (Table 1). Hence the per cent reduction over farmer's practice was found to be maximum in IPDMmodule (75.11% and 69.52 %) through followed by Module II IPDM (73.70% and 66.19 %) (Table 1). The yield of green chilli and BC ratio were found to be high in IPDM module (22.96 t/ha and 3.02) followed by Insecticide Module (19.14 t/ha and 2.78) and farmer's practice (13.88 t/ha and 1.49).[5]confirmly reported the Module-IV Mulch + Installation of blue sticky traps.+ Need based application of insecticides was most effective. Higher chilli yield of 32.22 q/ha with 87.08 % increase over untreated control followed by Module-I and Module-III and they were at par with each other with recorded yield of 30.55 q/ha and 27.77 q/ha respectively with 86.37% and 85.01% increase over control.[7] reported that several IPM approaches like timely planting, mulching, balanced use of nitrogenous fertilizers, installation of blue sticky traps, spraying of biopesticides and microbial pesticides and some insecticides like Spirotetramat @ 160g/acre, tolfenpyrad 15 EC @ 1 ml/L of water, spinetoram 11.7 SC @1 ml/L aginst the *thrips parvispinus* in chilli growing areas.~~

4.CONCLUSION

The mean thrips population revealed that Module I IPDM module recorded low thrips population (1.05 Nos./leaf and 0.64 nos/Sq.m^2 leaves) followed by Module II IPDM (1.11 Nos./leaf and 0.71nos/Sq.m^2 leaves). A virus incidence of 1.0 to 2.0 ~~percent~~% was recorded in Treatment 2 module II and Treatment 3 Farmers practices 2.2 to 9.5 ~~percent~~% was observed. The thrips and tospovirus incidence was positively

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correlated with weather parameters and mite populaiton was negatively correlated with weather parameters.The ~~Percent~~% reduction over control of thrips population is highest in T1 followed by T2 and then farmer practice (81.70,80.66 and 56.48%).The ~~percent~~% reduction over control of tospovirus by thrips is highest in T1 IPDM module followed IPDM II than farmer practice (100,88.88 and 54.40%).The yield of green chilli and BC ratio were found to be high in IPDM module (22.96 t/ha and 3.02) followed by Module II IPDM (19.14 t/ha and 2.78) followed by farmer's practice (13.88 t/ha and 1.49).

Data Availability

Research data is available with the authors and shall be provided upon request.

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Table 1.Roving survey on incidence of thrips transmitted by Tospovirus and mite population in Pennagaram and Palacode block of Dharmapuri district in Chilli crop ecosystem

Months	Villages	Palacode block			Pennagaram block		
		Thrip/leaves	Mite/leaves	Virus incidence (%)	Thrip/leaves	Mite/leaves	Virus incidence (%)
September	Somanalli	0.50	0.20	0.0	1.00	0.20	0.00
	Elumichanahalli	0.20	0.40	0.0	1.67	0.50	0.00
	Kattampatti	0.70	0.60	0.0	1.70	0.11	0.00
	Indamangalam	2.00	0.30	3.5	0.80	1.00	0.00
October	Somanalli	1.00	0.30	0.0	3.50	0.50	3.50
	Elumichanahalli	1.70	1.20	0.0	2.80	1.00	0.00
	Kattampatti	0.60	0.50	0.0	1.80	1.00	0.00
	Indamangalam	2.30	1.70	4.50	2.00	1.50	9.50
November	Somanalli	1.00	1.40	0.0	3.10	0.90	5.00
	Elumichanahalli	2.00	0.30	3.0	1.40	1.80	0.00
	Kattampatti	2.50	1.20	4.50	1.00	0.80	0.00
	Indamangalam	1.90	0.80	0.0	1.60	1.00	0.00
December	Somanalli	3.00	1.40	9.0	1.90	1.00	2.00
	Elumichanahalli	2.20	0.60	4.0	1.80	0.60	0.00
	Kattampatti	2.50	0.70	4.0	2.40	1.00	5.00
	Indamangalam	1.40	0.90	0.0	1.70	0.60	0.00
Janauary	Somanalli	1.10	0.80	0.0	1.90	0.20	2.00
	Elumichanahalli	2.00	0.20	4.50	2.40	0.50	4.50
	Kattampatti	1.80	0.00	0.0	1.60	0.40	0.00
	Indamangalam	2.10	0.10	3.5	1.50	0.20	0.00
Mean		**1.63**	**0.68**	**2.03**	**1.88**	**0.74**	**1.58**

Table 2.Evaluation of different IPDM modules for the management of chilli thrips transmitted tospoviruses complex during 2023-2024

Treatments	Mean number of thrips/leaf								Per cent redn. over FP	Yield t/ha	BC ration
	1 WAT	3 WAT	5 WAT	7 WAT	9 WAT	11 WAT	13 WAT	Mean			
T1- IPDM Module I	0.66[a] (0.81)	0.46[a] (0.67)	0.32[a] (0.56)	0.96[a] (0.97)	2.52[a] (1.58)	1.96[a] (1.4)	0.48[a] (0.69)	1.05	81.70	22.96[a] (4.79)	1:3.02
T2- Module II	0.84[b] (0.91)	0.62[a] (0.78)	0.46[a] (0.67)	1.60[a] (1.26)	3.16[b] (1.77)	2.14[b] (1.46)	1.02[b] (1.00)	1.11	80.66	19.14[b] (4.37)	1:2.78
T3 – Farmers' practice	2.14[b] (1.14)	3.32[b] (1.82)	4.32[b] (2.07)	5.16[b] (2.27)	6.46[c] (2.54)	5.02[c] (2.24)	3.12[c] (1.76)	4.22	26.48	13.88[c] (3.72)	1:1.49
T4- Untreated check	3.15[c] (1.77)	3.98[b] (1.99)	4.88[b] (2.20)	5.89[b] (2.42)	7.27[c] (2.69)	7.34[c] (2.70)	7.69[c] (2.77)	5.74	-	11.95[d] (3.45)	1:1.35
SE (d)	0.216	0.277	0.530	0.732	0.366	0.806	0.237				
CD (0.05)	0.452	0.58	1.107	1.530	0.760	1.684	0.496				

*Mean of seven replications
WAT-Weeks after transplanting
Figures in parentheses are *square root* transformed values; In a column, means followed by a common letter(s) are not significantly different by DMRT (P=0.05).

Table 3.Evaluation of different IPDM modules for the management of mite in chilli during 2023-2024

Treatments	Mean number of mite/leaf					Per cent redn. Over FP
	9 WAT	11 WAT	13 WAT	15WAT	Mean	
T1- IPDM Module I	0.62[a] (0.79)	0.34[a] (0.58)	0.68[a] (0.82)	0.44[a] (0.66)	0.64	79.61
T2- Module II	0.74[ab] (0.86)	0.58[a] (0.76)	0.96[b] (0.98)	0.82[b] (0.91)	0.71	77.38
T3 – Farmers' practice	1.20[bc] (1.10)	1.80[b] (1.34)	2.32[c] (1.52)	3.08[c] (1.75)	2.10	
T4-Untreated check	2.02[c] (1.14)	2.62[b] (1.61)	3.69[c] (1.92)	4.26[d] (2.06)	3.14	33.12
SE (d)	0.290	0.264	0.310	0.504		
CD (0.05)	0.606	0.553	0.649	1.053		

*Mean of seven replications
WAT-Weeks after transplanting
Figures in parentheses are *square root* transformed values; In a column, means followed by a common letter(s) are not significantly different by DMRT (P=0.05).

Table 4.Evaluation of different IPDM modules for incidence of tospovirus by thrips in Chilli

Treatments	Mean number of tospovirus incidence					Per cent redn. over FP
	7 WAT	9 WAT	9 WAT	13WAT	Mean	
T1- IPDM Module I	0.0	0.0	0.0	0.0	0.00	100.00
T2- Module II	0.0	1.0	2.0	2.0	1.25	88.88
T3 – Farmers' practice	2.2	4.0	5.0	9.5	5.17	54.40
T4. Untreated check	2.56	4.50	6.50	10.50	11.25	-

Mean of seven replications
WAT-Weeks after transplanting
Figures in parentheses are arcinetransformed values; In a column, means followed by a common letter(s) are not significantly different by DMRT (P=0.05).

Fig. 1. Roving survey of insects pest and virus incidence in Chilli ecosystem in Palacode block

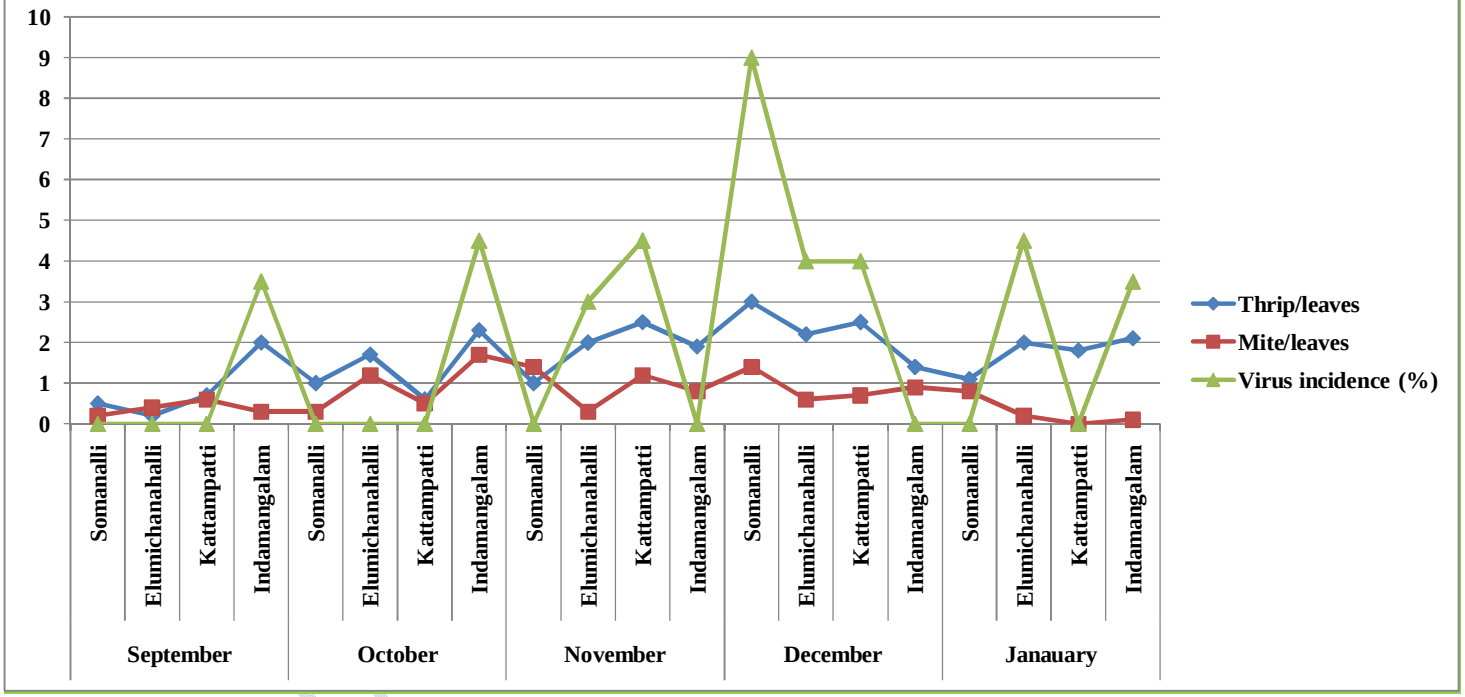
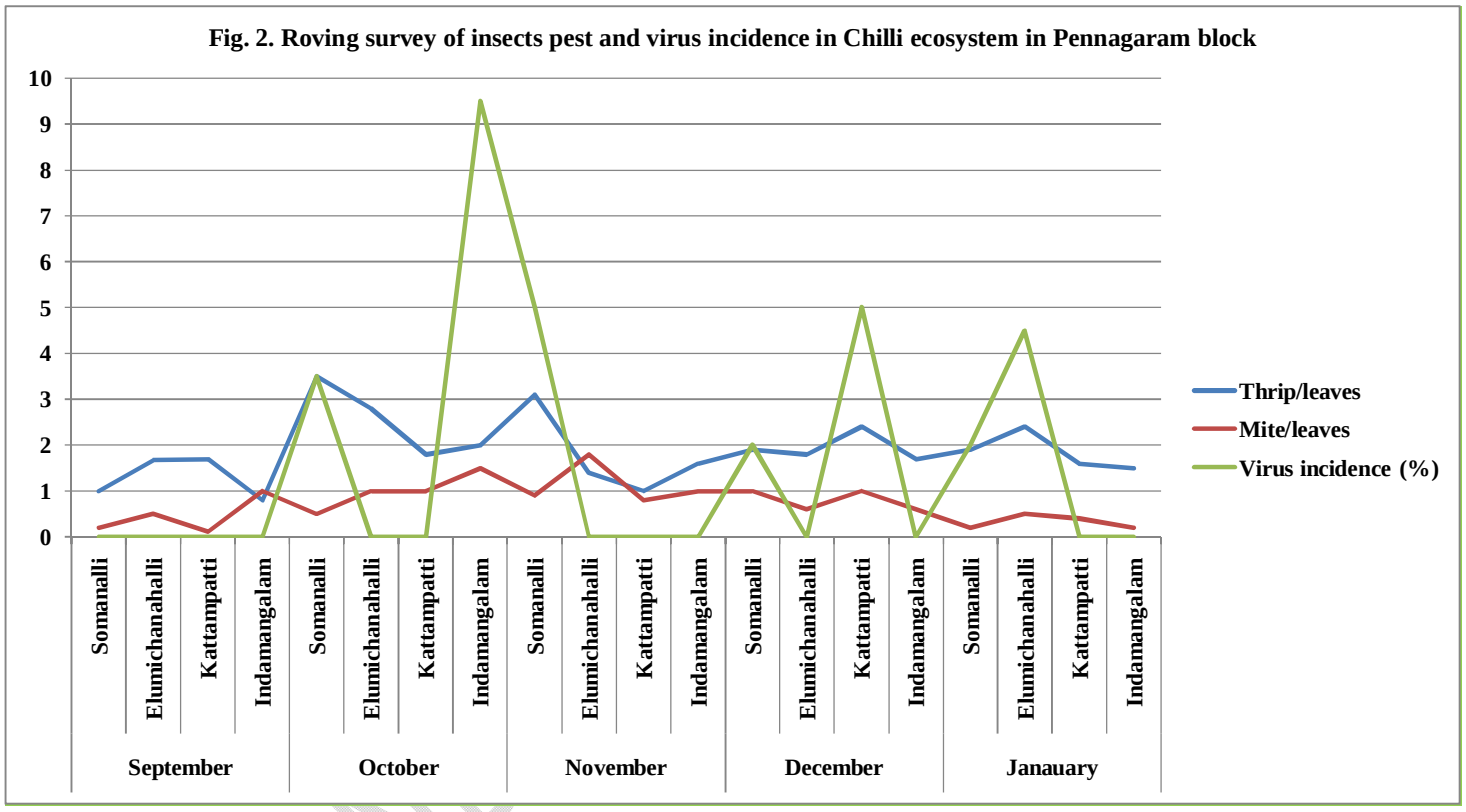


Fig. 2. Roving survey of insects pest and virus incidence in Chilli ecosystem in Pennagaram block



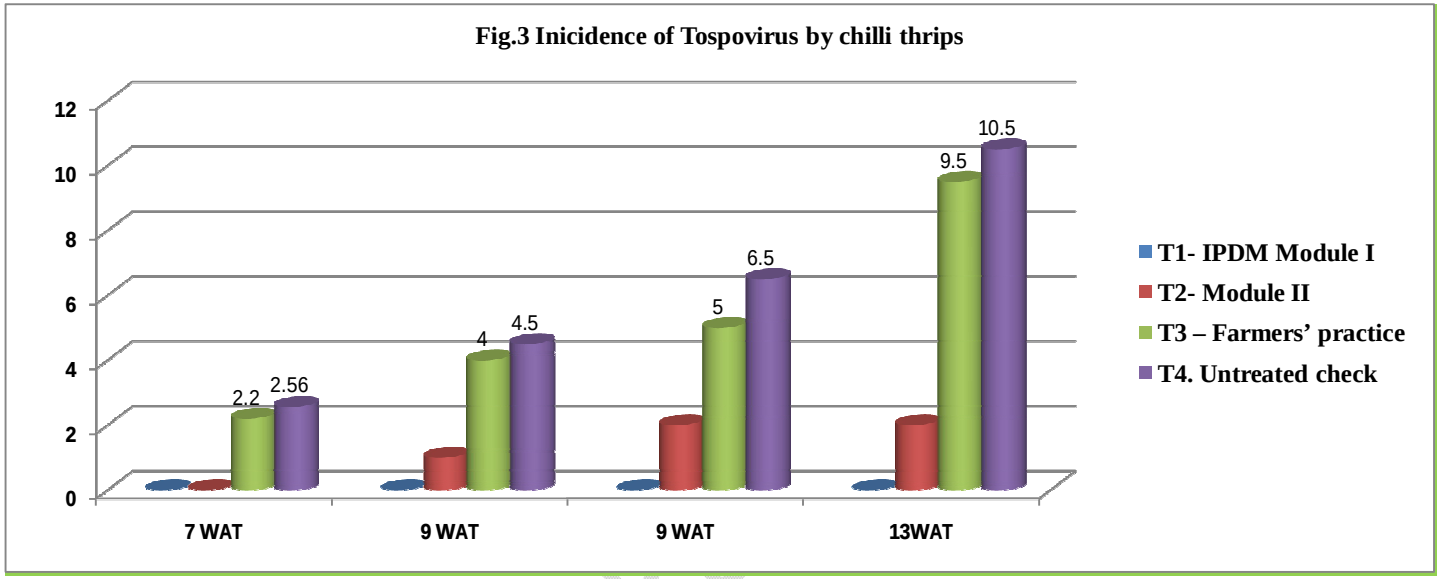


Fig.3 Inicidence of Tospovirus by chilli thrips
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T1- IPDM Module I
T2- Module II
T3 – Farmers' practice
T4. Untreated check