



Population Dynamics of Thrips, *Scirtothrips dorsalis* Hood Infesting Chilli as Influenced by Biotic and Abiotic Parameters in Southern Karnataka

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Authors' contributions

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

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ABSTRACT

Population dynamics of thrips, *Scirtothrips dorsalis* Hood as influenced by biotic and abiotic factors on chilli crop under Bengaluru conditions (IIHR, Hessaraghatta & GKVK) and Kotagal (near Chintamani) was studied during Kharif and Rabi seasons of 2015-16 and 2016-17. During Kharif season of 2015-16, peak population of thrips was 28.87 thrips / plant when the crop age was 83 days old (42nd Std week), coincided with II FN of October. Also, a second peak (11.53 thrips plant⁻¹)

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on Kharif crop was during mid – December (49th Std week), under GKVK condition also first and second peaks were recorded during October and end of November, respectively. During 2016-17 thrips incidence was relatively low (3 thrips) at th Std week and modest (8.33) during early December (Std week 48) when the crop nearing maturity. A more similar trend was observed under Chintamani condition. On Kharif crop of 2015-16, a more evident peak (26.33 thrips) was during I FN of March (11th Std week) when the crop age was 94 days under IIHR conditions. Similarly, under GKVK and Chintamani conditions also the peak thrips population was recorded during mid-March i.e., 53.30 and 40.60 thrips plant⁻¹, respectively. Similar trend was recorded in 2016-17 Kharif season, thus, over all activity of chilli thrips on Kharif crops across three locations was more prominent during February-March period. overall influence of different weather parameters across three different locations indicated maximum temperature, bright sunshine hours, evaporation and natural enemies during the cropping period significantly influenced the buildup of thrips, while minimum temperature, rainfall, wind speed, and crop age (phenology) were observed to affect the thrips population adversely.

Keywords: Population dynamics; thrips; chilli.

1. INTRODUCTION

“Chilli (*Capsicum annum* L.) is one of the important spice cum vegetable crops grown for domestic market as well as export purpose. About 25 insects have been recorded infesting chilli leaves and fruits, of which, thrips, *S. dorsalis* is considered as the most serious and important pest” [1,2]. “The symptoms of chilli leaf curl malady caused by feeding injury of thrips. The variability in thrips populations on crops is determined by the natural growth of the population and the influence of weather on thrips activity and their multiplication rate” [3]. “An understanding of the factors that influences such population changes is essential in predicting the population of thrips. Weather variables including rainfall, temperature, relative humidity and wind speed have been reported as important factors that significantly affect thrips numbers” [4,3,5,6]. A basic understanding of the relationship of weather factors with thrips population is important in developing an integrated management strategy for thrips on chilli crop and in planning suitable control measures under a given set of climatic conditions. The prime objective of the present study was to determine

the population fluctuation pattern of thrips on chilli crop in different locations and to investigate on the association of population density of thrips with weather parameters, natural enemy’s abundance and phenology of the crop. The data generated as well would be useful for predicting chilli thrips outbreaks under varied climatic conditions and to evolve suitable control / management strategies.

2. MATERIALS AND METHODS

To study the population dynamics of thrips, *S. dorsalis* under field conditions, the chilli crop was grown in 0.2 ha area with a spacing of 60×30cm during May-June period in Kharif season and during October-November period in the r season. The study was carried out at the Vegetable block of Indian Institute of Horticultural Research, Hessaraghatta, Bengaluru (Var. Arka Meghana), GKVK, Bengaluru (var. Byadgi) and in farmer’s field (Namadari 1100) at Kotagal near Chintamani during Kharif and Rabi seasons of 2015-16 and 2016-17 as given here under. All the recommended agronomic practices except plant protection measures were followed for raising the chilli crops over different seasons.

Table 1. Studying population dynamics of chilli thrips, *Scirtothrips dorsalis* in different seasons across three different locations

Period	Season	IIHR, Bengaluru (var. Arka Meghana)	Chintamani (var. Namadari 1100)	GKVK, Bengaluru (var. Byadgi)
2015-16	Kharif	✓	-	✓
	Rabi	✓	✓	✓
2016-17	Kharif	✓	✓	-
	Rabi	✓	✓	-

The whole experimental plot was divided into three equal quadrates as replicates. Population of thrips was recorded at weekly interval (IIHR, Hesaraghatta & GKVK, Bengaluru) and fortnightly interval (farmer's field in Kotagal near Chintamani) from five randomly selected plants in each quadrate by following the method of tapping the growing tip of the plant on a white acrylic sheet. Population data were collected as soon as the activity of thrips was noticed in the field and was continued up to crop maturity (final picking/harvest of fruits). The data recorded were expressed as average number of thrips (from 3 tappings/plant).

To determine the effect of weather parameters on the seasonal dynamics of *S. dorsalis* on chilli crop, meteorological data of IIHR farm, GKVK and Kotagal village near Chintamani were used. Weather data (max. & min. temperatures, morning and afternoon relative humidity, evaporation, wind speed, rainfall and sunshine hours), activity/abundance of natural enemies and crop age (as independent variables) and thrips population data (as dependent factors) were subjected to Correlation and Multiple Regression Analysis (Stepwise Regression Analysis) to determine the overall influence of these factors (across Kharif -Rabi seasons) on the activity of thrips during the cropping period.

3. RESULTS AND DISCUSSION

3.1 Thrips Activity during Kharif Season

Seasonal activity of thrips studied on chilli during Kharif 2015-16 under IIHR, Bengaluru conditions indicated the gradual buildup of the pest from 55 days age of chilli crop to register peak thrips population (0.13 to 28.87 thrips plant⁻¹) by 42nd Std week (II FN of October) when the crop was 83 days age. A second peak population of 11.53 thrips during mid-December. Under GKVK, Bengaluru conditions also an early distinct peak (18.90 thrips plant⁻¹) by first week of October 2015 was recorded when the crop age was 69 days. A more distinct second peak (10.47 thrips/plant) was noticed during last week of November (47th Std week) (Table 2).

Similarly, Kharif 2016 season crop under IIHR conditions also experienced an early distinct peak (3 thrips/plant) when the crop age was 62 days old during 30th Std week. Fluctuating population further recorded a more similar peak of 8.33 thrips plant⁻¹ during 48th Std week, when the crop was nearing maturity. A more similar

trend was observed under Chintamani conditions on June to Dec. 2016 crop *i.e.*, initiation of thrips population on 55 days old crop leading to a peak of 8.53 thrips plant⁻¹ during II FN of October when the crop age was 97 days (Table 3) sportingly, population dynamics studies spread over different states of Uttar Pradesh (Varanasi and Allahabad region) [7,8], Rajasthan (Udaipur region) [9], Gujarat (Anand region) [10,11] and Maharashtra (Parbhani region) [12] have revealed the major activity of *S. dorsalis* on improved chilli varieties (Pusa Jwala, G-4 and S-49) during the rainy season, starting from September onwards with peak thrips activity during October to November, particularly during I FN of October.

Secondary activity of thrips leading to an additional distinct peak during end of November (47th Std week) at GKVK, Bengaluru (on var. Byadgi Kaddi) and 48th Std week at IIHR, Bengaluru (on var. Arka Meghana) are comparable to greater abundance of thrips reported in Orissa [13], in Karnataka (Dharwad region) [14], in Gujarat (Anand region) [15] and in Uttar Pradesh (Allahabad region) [16], who also recorded greater thrips activity between end of November and beginning of December, on traditional or improved chilli varieties (like, GVC-111, LCA-334, Byadgi and Suryamukhi). Continuous activity of chilli thrips throughout the year observed in the present study may be attributed to all time availability of the crop in the field. Major thrips activity which starts from the early crop stage of 55-75 days age in the present study corroborated with the early rainy season activity of thrips during August in Manipur [17] and in Rajasthan [17].

3.2 Thrips Activity during Rabi Season

Chilli as Rabi season crop at IIHR, Bengaluru in the present study experienced more gradual activity of thrips from the mid February (8th Std Week) to record a single distinct peak (26.33 thrips plant⁻¹) of the season during middle of March (11th Std. week) on 94 days crop during 2015-16. Under GKVK conditions also Rabi crop recorded peak (53.30 thrips/plant) thrips activity during mid-March (12th Std. week), associated with the approximate crop age of 100 days. Under Chintamani conditions, the peak (40.60 thrips plant⁻¹) activity of thrips was evident between mid-February (in 2016-17 crop) and mid-March (in 2015-16 crop). Thus, overall activity of chilli thrips on Rabi crops across three locations

in the present study was more prominent during February-March period. In Dharwad region of Karnataka (Borah, 1987) and in the Anand region of Gujarat (Patel et al., 2009; Barot et al., 2012), also, higher thrips abundance was reported during February-March period, as noticed in the present study.

Table 2. Population of thrips, *Scirtothrips dorsalis* on chilli crop during 2015-16 (Kharif season at IIHR and GKVK. Bengaluru

Standard Week	Crop age (days)	Number of thrips (Natural enemies)	
		IIHR	GKVK
38	55	0.13 (0.13)	2.33 (0.30)
39	62	0.20(00)	7.97 (0.47)
40	69	0.53(0.07)	18.90 (0.33)
41	76	10.60(0.33)	17.66 (0.40)
42	83	28.87(0.2)	13.37 (0.37)
43	90	17.27(0.33)	8.17 (00)
44	97	10.27(0.33)	2.30 (00)
45	111	12.27(0.40)	3.27 (0.20)
46	118	3.33(0.27)	7.33 (0.37)
47	125	3.80(0.13)	10.47 (0.37)
48	132	5.20(0.07)	7.40 (0.33)
49	139	11.53(0.27)	8.57 (0.43)
50	146	7.20(0.40)	9.30 (0.47)
51	153	7.87(0.20)	5.77 (0.50)
1	160	5.67(0.33)	2.07 (0.73)
2		4.53(0.13)	1.10 (0.50)

* Mean from three young shoots plant¹.

Table 3. Population of thrips, *Scirtothrips dorsalis* on chilli crop during 2016-17 (Kharif season at IIHR. Bengaluru and Kotagal (near Chintamani)

Standard Week	Crop age (days)	Number of thrips (Natural enemies)		Fortnight
		IIHR	Chintamani	
29	55	1.73 (0.13)	2.70 (0.23)	Jul II (55)
30	62	3.00 (0.40)	4.20 (0.37)	Aug I (70)
31	69	0.27 (0.53)	5.00 (0.37)	Aug II (85)
32	76	1.60 (00)	4.77 (0.73)	Sep I (100)
33	83	2.20 (0.2)	7.67 (0.60)	Sep II (115)
34	90	0.93 (0.13)	8.20 (0.73)	Oct I (130)
35	97	1.27 (0.60)	8.53 (0.77)	Oct II (145)
36	104	0.33 (0.40)	7.40 (0.33)	Nov I (160)
37	111	0.67 (0.40)	6.53 (0.43)	Nov II (175)
38	118	0.47 (2.47)	5.33 (0.80)	Dec I (190)
39	125	0.27 (2.47)	-	-
40	132	0.60 (1.00)		
41	139	0.33 (0.40)		
42	146	2.07 (1.13)		
43	153	3.20 (0.73)		
44	160	1.40 (0.27)		
45	167	2.60 (0.27)		
46	174	6.33 (0.67)		
47	181	7.27 (0.60)		
48	188	8.33 (0.53)		
49	195	2.40 (0.13)		
50	202	3.60 (0.33)		

* Mean from three young shoots plant¹

Table 4. Population of thrips, *Scirtothrips dorsalis* on chilli crop during 2015-16 (Rabi season at IIHR and GKVK. Bengaluru

Standard Week	Crop age (days)	Number of thrips (Natural enemies)		Fortnight (crop age)	Number of thrips (Natural enemies)
		IIHR	GKVK		
6	60	0.80 (0.27)	1.60 (00)	Jan I(60)	5.43 (62)
7	67	1.07 (0.27)	5.80 (0.47)	Jan II(75)	6.00 (77)
8	74	6.40 (0.27)	9.50 (0.53)	Feb I (90)	17.70 (91)
9	81	7.13 (1.20)	17.27 (0.60)	Feb II (105)	27.70 (106)
10	87	24.67 (1.27)	27.83 (0.57)	Mar I (120)	40.60 (120)
11	94	26.33 (1.27)	48.00 (1.03)	Mar II (135)	36.33 (135)
12	101	16.33 (0.53)	53.30 (0.73)	Apr I (150)	21.70 (149)
13	108	15.47 (0.82)	23.77 (0.60)	Apr II (165)	13.20 (165)
14	115	9.60 (0.47)	17.43 (0.47)	May I (180)	10.00 (178)
15	122	12.13 (0.13)	15.70 (0.40)	May II (195)	7.00 (195)
16	129	7.47 (0.40)	10.30 (0.23)		
17	136	7.27 (0.27)	11.50 (0.20)		
18	143	5.53 (0.27)	12.27 (0.50)		
19	150	-	11.53 (150)		
20	157	-	10.13 (157)		
21	164	-	3.77 (164)		

* mean from three young shoots/plant

Table 5. Population of thrips, *Scirtothrips dorsalis* on chilli crop during 2016-17 (Rabi season at IIHR. Bengaluru and Kotagal (near Chintamani)

Standard Week	Crop age (days)	Number of thrips (Natural enemies)		Fortnight (Crop age)	Number of thrips (Natural enemies)
		IIHR	Chintamani		
52	66	7.00(00)		Jan I (65)	3.73 (00)
1	73	4.07(0.1)		Jan II (80)	24.83 (0.30)
2	80	8.27(00)		Feb I (95)	48.30 (0.47)
3	87	11.60(00)		Feb II (110)	55.63 (0.47)
4	94	35.13(0.1)		Mar I (125)	26.80 (0.47)
5	101	33.93(0.1)		Mar II (140)	25.53 (0.10)
6	108	44.53(00)		Apr I (155)	22.90 (0.67)
7	115	23.33(00)		Apr II (170)	11.53 (0.63)
8	122	29.13(00)		-	-
9	129	15.20(00)			
10	136	5.20(0.3)			
11	143	0.53(0.3)			

* Mean from three young shoots plant¹.

Table 6. Correlation coefficient and regression analysis of thrips population with abiotic (weather factors) and biotic factors (natural enemies & crop age) at different locations

Location	Correlation		Regression		Step-wise regression	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
IIHR, Bengaluru	Max. Temp. (0.41*)	Min. Temp. (-0.63**)	Wind speed (7.09*)	Min. Temp (-3.09*)	Min. Temp (1.50)	Min. Temp (-4.35)
	Evap. (0.41*)	MRH (-0.52**)	Nat. enemies (29.08**)	ARH (0.84*)	Nat. enemies (38.72)	Evap. (5.29)
	Nat. enemies (0.70**)	ARH (-0.43*)			$\hat{Y}=28.05+1.5T_{min}$	ARH (0.56)
		Nat. enemies (-0.46**)			+38.72NE	$\hat{Y}=$
		Wind speed (-0.41*)				44.53+5.29Evap
	Evap. (0.47**)				+0.56ARH -	
	SSH (0.44*)				4.35Tmin	
Chintamani, Chikkaballapur	Rainfall (-0.80**)	Max. Temp. (0.50*)	None	MRH (2.65**)	Rainfall (-1.56)	Evap. (13.57)
	SSH (0.80**)	ARH (-0.50*)		Wind speed (3.70*)	$\hat{Y}=-26.92-1.56RF$	$\hat{Y}=-27.60+$
		Evap. (0.72**)				13.57Evap.
	SSH (0.68**)					
GKVK, Bengaluru	Max. Temp. (0.43*)	-	Rainfall (-0.18*)	-	Max. Temp. (0.93)	-
	ARH (-0.36*)		Nat. enemies (37.22**)		Nat. enemies (32.85)	
	Nat. enemies (0.60**)		Plant age (-0.12*)		Plant age (-0.11)	
				$\hat{Y}=-17.03+0.93T_{max}$		
				+32.85NE-0.11crop age		

3.3 Influence of Abiotic and Biotic Factors on Thrips Activity

In the study period of 2015-17 the overall influence of different weather parameters across three different locations indicated significant (positive) influence of maximum temperature ($r=0.41^*$), evaporation ($0.41^*-0.47^{**}$), bright sunshine hours ($0.44^*-0.80^{**}$) and natural enemies (coccinellids and spiders) ($0.60^{**}-0.70^{**}$) and significant negative influence of minimum temperature ($r=0.63^{**}$), relative humidity {morning (0.52^{**}) & afternoon ($0.43^*-0.50^*$)}, rainfall (0.80^{**}) and wind speed (0.41^*) on the abundance as well as the activity of thrips. Hence, maximum temperature, bright sunshine hours, evaporation & natural enemies during the cropping period significantly influenced the buildup of thrips, while minimum temperature, rainfall, wind speed, and crop age (phenology) were observed to affect the thrips population adversely (Table 6). Yearwise step-wise regression analysis involving all the weather factors across three locations revealed that under IHR conditions more significant positive influence of minimum temperature and natural enemies ($\hat{Y} = -28.05 + 1.5T_{min} + 38.72NE$) during 2015-16 and significant positive impact of evaporation & afternoon relative humidity, significant negative influence of minimum temperature ($\hat{Y} = 44.53 + 5.29Ev_p + 0.56ARH - 4.35T_{min}$) during 2016-17 (Table 6).

Reports of maximum temperature favouring the buildup of thrips on chilli in Andhra Pradesh [15], in Gujarat [10,18], in Maharashtra [17,19], in Uttar Pradesh [9,7,16] and in Rajasthan [20] supported the apparent influence of maximum temperature observed in the present study. More significant influence of bright sunshine hours on thrips infestation in Sardar Krishinagar & Anand region of Gujarat [21,18], in Parbhani and Pune regions of Maharashtra [12,19], it might be due to higher maximum temperature. Negative impact of minimum temperature on chilli thrips build up has been reported from Orissa [15], from Dharwad region of Karnataka [14], from Anand of Gujarat [22,18], from Guntur of Andhra Pradesh [15] and from Udaipur of Rajasthan [20].

In Maharashtra [17,12], in Orissa [13], in Anand of Gujarat [10,18], in Guntur of Andhra Pradesh [15], in Varanasi of Uttar Pradesh [7] and in Udaipur of Rajasthan [19] reported that increase in rainfall significantly brought down thrips

population in chilli crop. Step-wise regression analysis revealed that under Chintamani conditions only rainfall (fortnightly) influenced thrips population adversely. Significant negative influence of rainfall and relative humidity (Afternoon) ($\hat{Y} = 9.273 - 0.026^* RF - 0.146^{**}RH_2$) on the activity of thrips in the Anand region of Gujarat [10].

From the results of earlier studies and the present findings it may be inferred that differential abundance of thrips across different locations might be attributed to favourable combination of ambient weather conditions and appropriate stage of chilli crop [23].

4. CONCLUSION

The present study generated data on the population fluctuation of thrips, *S. dorsalis* on chilli crop and the influence of ambient weather conditions on their build-up and activity. The chilli crop is being grown almost throughout the year, the probable incidence of this major pest needs to be managed with appropriate strategies, particularly on the middle aged crop (70-100 days old), more severely damaged coinciding with November-December (during rainy season) and February-March (during Rabi) periods. Further critical analysis of data relevant to dynamics of thrips buildup and associated infestation level over two years period (2015-17) revealed the severe damage of thrips on chilli crop during the Rabi season, particularly during February-March period under Bengaluru and Kotagal near Chintamani conditions. This is because as the number of thrips exceeded the apparent economic threshold level of 1 thrip leaf⁻¹ [15]. The corresponding Rabi peaks (during February-March period) in the present study were reasonably high (of 24.67 to 76.20 thrips young shoot⁻¹ (with at least 15 to 18 leaves) during Std. week 10 in 2016; 15.20 to 44.53 thrips during Std. week 6 in 2017) *i.e.*, more than the recommended ETL. This also necessitated our intervention for immediate control of thrips at Bengaluru and Kotagal (near Chintamani) during February-March period.

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 manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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