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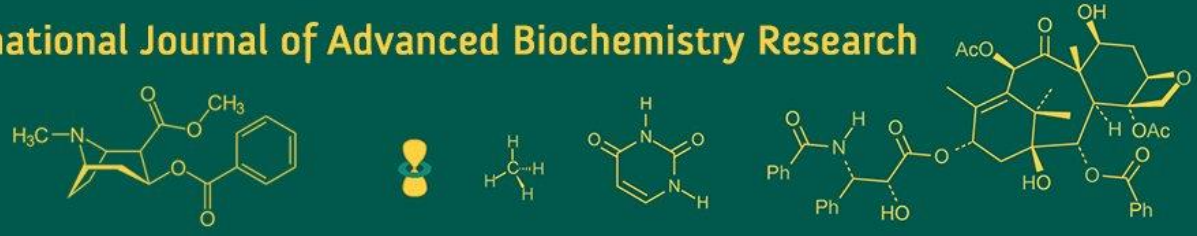

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Seasonal incidence and correlation studies of thrips infesting chilli with weather parameters

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Abstract
A field study was conducted to investigate the seasonal incidence of thrips on chilli crop, (*Capsicum annuum* L.) var. Phule-Jyoti, during the *kharif* season from September 2024 to January 2025 at the PG Research Farm, Division of Entomology, Dr. Sharadchandra Pawar College of Agriculture, Baramati, Maharashtra. The study revealed that the thrips infestation began in the second week of September (37th standard meteorological week) with an average population of 0.67 thrips/leaf/plant. The population peaked at 4.67 thrips/leaf/plant in the first week of November (44th standard meteorological week), coinciding with weather parameters viz. maximum temperature of 33.3 ^{0}C, minimum temperature of 20.6 ^{0}C, morning relative humidity of 92%, evening relative humidity of 53%, wind velocity of 5.4 km/hour and sunshine hours of 6.6 hours/day. A secondary peak of 3.93 thrips/leaf/plant occurred in the first week of December (48th standard meteorological week) with a maximum temperature of 32.7 ^{0}C and sunshine hours of 7.8 hours per day. The population declined to 1.84 thrips/leaf/plant by the second week of January (2nd standard meteorological week) as maximum temperature and sunshine hours decreased. Correlation analysis revealed significant positive correlations between thrips population and maximum temperature (r = 0.465) and sunshine hours (r = 0.614), a non-significant positive correlation with morning relative humidity (r = 0.019), and non-significant negative correlations with minimum temperature (r = -0.071), evening relative humidity (r = -0.354), wind velocity (r = -0.357), and rainfall (r = -0.288). These findings underscore the role of maximum temperature and sunshine hours in driving thrips population dynamics, aiding in the development of timely pest management strategies for chilli cultivation.

Keywords: Chilli (*Capsicum annum* L.), thrips, seasonal incidence, weather parameters, correlation analysis, pest management

Introduction
Chilli (*Capsicum annuum* L.), a vital solanaceous vegetable crop, is a dietary and economic cornerstone in India, prized for its pungent fruits rich in vitamins A and C, minerals like potassium and magnesium, and capsaicin, which imparts distinctive pungency and flavour (Bhatt and Karnatak, 2020) [2]. Used as a vegetable, spice, condiment, and in sauces and pickles, chilli's nutritional and medicinal properties enhance its global demand across tropical and subtropical regions (Zainab *et al.*, 2016) [18]. Its vibrant colour and versatility in culinary applications underscore its export potential (Borgohain, 2024) [5]. Chilli's role in traditional medicine further elevates its significance (Meena *et al.*, 2013) [10]. In 2023-24, India led global chilli production, cultivating 418 thousand hectares to yield 4.46 million tonnes at 10.67 tonnes per hectare (National Horticulture Board, 2024). This dominance is driven by rising consumption in culinary and processed food industries (Zainab *et al.*, 2016) [18]. Maharashtra, ranking fifth nationally, produced 415.32 thousand tonnes from 38.12 thousand hectares, reflecting chilli's critical role in the state's horticultural economy and rural livelihoods (National Horticulture Board, 2024) [11].

Thrips, notably *Scirtothrips dorsalis* Hood and *Thrips parvispinus* Karny, are major pests, attacking over 100 hosts and causing 50-90% yield losses through sap-feeding and virus transmission (Butani, 1976) [6]. Their feeding leads to leaf curling, silvering, bronzing, and stunted growth, impairing photosynthesis and plant vigour (Kumar, 1995) [9]. The short 10-15 days life cycle of thrips enables multiple generations per season, rapidly escalating infestations (Pathipati *et al.*, 2014) [14].

This necessitates vigilant monitoring to curb economic damage (Bokan *et al.*, 2015) [4]. Thrips transmit chilli leaf curl virus, triggering the "murda complex" with symptoms like leaf distortion, chlorosis, reduced leaf size, and fruit malformation (Nelson and Natarajan, 1994) [12]. These effects drastically reduce marketable yield and quality, sometimes causing complete crop failure (Samanta *et al.*, 2017) [15]. Chemical controls, while initially effective, risk pest resistance and environmental harm (Tommasini and Maini, 1995) [17]. Sustainable and integrated pest management approaches are thus critical (Chinniah *et al.*, 2016) [7].

Weather parameters like temperature, humidity, rainfall, wind velocity and sunshine hours critically influence thrips population dynamics across agro-climatic zones (Patel *et al.*, 2009) [13]. These factors modulate thrips abundance and damage potential (Barot *et al.*, 2012) [1]. This study examines the seasonal incidence of thrips on Phule-Jyoti variety of chilli crop and their correlation with weather factors to devise weather-based integrated pest management strategies for sustainable chilli production.

2. Material and Methods

2.1 Site of Field Experiment

The present experiment was conducted at the PG Research Farm, Division of Entomology, Dr. Sharadchandra Pawar College of Agriculture, Baramati, Maharashtra, during the *kharif* season 2024-25. The geographical details of the site are 18°09' N latitude, 74°34' E longitude, and 538 meters above from mean sea level (MSL).

2.2 Experimental Layout

The present experiment was conducted on chilli crop var. "Phule-Jyoti" (*Capsicum annuum* L.). The seedlings were raised in nursery beds and 45 days old seedlings were transplanted in a plot at a distance of 60 cm between rows and 45 cm between plants on raised beds in the main field during 1st week of September 2024. All recommended agronomic package of practices except the plant protection measures were adopted for raising the chilli crop.

2.3 Observations Recorded

The pest population observations were recorded at seven days interval, from the initiation of the thrips infestation and was continued up to harvest. Observations were recorded from each experimental plot having five plants which were selected and tagged further; detailed observations were made at weekly intervals on the incidence of thrips. The population of thrips, were recorded from three leaves one each from the upper, middle and lower position on five selected plants. For recording observations, magnifying lens (10 X) was used to visualise and collect thrips from chilli plants and then population count of collected thrips was recorded under stereo binocular microscope.

2.4 Meteorological Data

The meteorological data on different weather parameters viz. temperature (maximum & minimum in °C), relative humidity (morning & evening in %), total rainfall (mm), wind velocity (Km/hr) and bright sunshine hours (hr/day) during the period of investigation were collected from the Agro-meteorological Department, NIASM, Baramati.

2.5 Correlation studies

A simple correlation coefficient (r) method was adopted to work out the relationship between the incidence of the thrips population and the weather parameters. The data thus obtained were converted into the average number of thrips per plant and represented in Table 1 and graphically depicted in Fig. 1.

3. Results and Discussion

3.1 To study the seasonal incidence of thrips infesting chilli during kharif season, 2024-25

The seasonal incidence of thrips on Phule-Jyoti variety of chilli during *kharif* 2024-25 at Baramati, Maharashtra, demonstrated periodic fluctuating patterns in thrips bionomics. Thrips infestation was observed from the 37th Standard Meteorological Week (SMW; second week of September) to the 2nd SMW (second week of January 2025), with mean counts of thrips population ranging from 0.67 to 4.67 thrips/leaf/plant. The initial incidence of 0.67 thrips/leaf/plant was observed in the 37th SMW, following the post-monsoon transition, when the maximum and minimum temperatures recorded were 32.7 °C and 21.3 °C with morning relative humidity 91% and evening relative humidity 56%. This rate gradually increased, peaking at 4.67 thrips/leaf/plant during the 44th SMW where temperature recorded was 33.3 °C maximum temperature and 20.6 °C minimum temperature, whereas morning relative humidity recorded was 92% and evening relative humidity of 53%. A secondary peak of 3.93 thrips/leaf/plant occurred in the 48th SMW with temperature 32.7 °C maximum and 18.6 °C minimum, relative humidity 87% morning and 40% evening. Further driven by declining temperatures and crop senescence, the population declined to 1.84 thrips/leaf/plant in the 2nd SMW. This indicates high-risk windows of severe thrips infestation in the 42nd SMW to 48th SMW. The data regarding to this is illustrated in Table. 1 and Fig. 1.

3.1.1 Correlation studies of thrips infesting chilli with weather parameters

Correlation analysis of thrips populations with weather parameters during *kharif* 2024-25, is depicted in Table 1 and presented graphically in Fig 1. The data revealed a significant positive correlation between thrips incidence and maximum temperature (r = 0.465) as well as sunshine hours (r = 0.614). however, there was a non-significant positive correlation with morning relative humidity (r = 0.019). On the other hand, the thrips incidence exhibited a non-significant negative correlation with minimum temperature (r = -0.071), evening relative humidity (r = -0.354), wind velocity (r = -0.357) and rainfall (r = -0.288).

Tirkey *et al.* (2020) reported a biphasic trend in chilli thrips populations with November and December peaks, mirroring the surges in thrips population here due to post-monsoon warming. Patel *et al.* (2009) [13] observed maximum infestation in late October to early November and positive sunshine correlations with thrips incidence, corroborating the extended daylight role in November-December peaks. Barot *et al.* (2012) [1] documented dry-spell surges, consistent with the early upsurge amid low rainfall. Bokan *et al.* (2015) [4] noted major pest peaks in mid to late autumn, supporting the secondary December rise from prolonged sunshine hours. Samanta *et al.* (2017) [15] highlighted December secondary peaks linked to residual warmth,

validating the pattern, while the January decline echoes their observed cooler-phase reductions and minor minimum temperature role. Bhede *et al.* (2008) [3] reported positive maximum temperature correlations, aligning with November buildup. Meena *et al.* (2013) [10] found non-significant negative effects of rainfall and humidity, supporting January declines. Havanoor and Rafee (2018) [8] described wind velocity's negative impact, matching the dispersive effect thrips incidence. Zainab *et al.* (2016) [18] corroborated strong sunshine correlations, validating December's secondary peak. These insights affirm the study's biphasic dynamics and weather correlations, enabling to formulate better pest management stratergies.

Table 1: Seasonal incidence of thrips infesting chilli and their correlation with weather parameters during *kharif* season, 2024-25.

Date of observations	SMW	No. of thrips/leaf/plant	Weather parameters						
			Temperature (°C)		Relative humidity (%)		Wind velocity (km/hr)	Sunshine (hrs/day)	Rainfall (mm)
			Max.	Min.	Morning	Evening			
08-09-2024	36	0.00	30.2	21.1	90	63	9.7	3.7	0.5
15-09-2024	37	0.67	32.7	21.3	91	56	6.6	5.1	10.5
22-09-2024	38	0.56	30.3	21.3	95	70	6.5	4.0	8.7
29-09-2024	39	1.58	29.5	20.7	91	69	7.5	3.2	1.6
06-10-2024	40	2.13	30.1	21.2	88	64	11.7	6.4	0.1
13-10-2024	41	2.84	30.3	19.4	92	58	7.9	5.2	1.3
20-10-2024	42	3.56	32.6	20.2	90	45	7.0	6.0	4.5
27-10-2024	43	3.04	30.6	20.8	94	69	6.9	5.4	6.1
03-11-2024	44	4.67	33.3	20.6	92	53	5.4	6.6	0.2
10-11-2024	45	3.47	31.7	21.4	91	54	6.5	6.5	0.9
17-11-2024	46	3.24	31.0	20.9	96	64	5.7	6.3	10.7
24-11-2024	47	3.51	31.6	18.5	93	42	4.6	8.7	0.1
01-12-2024	48	3.93	32.7	18.6	87	40	4.3	7.8	0.0
08-12-2024	49	3.31	31.3	15.9	86	35	3.8	7.1	0.0
15-12-2024	50	2.91	30.0	16.6	81	43	3.5	5.3	0.0
22-12-2024	51	2.53	29.2	12.7	87	35	2.8	7.6	0.0
29-12-2024	52	2.22	28.2	13.2	80	35	3.3	5.7	0.0
05-01-2025	1	2.56	31.2	19.4	86	47	4.8	5.6	0.0
12-01-2025	2	1.84	29.2	11.9	83	33	3.6	8.0	0.0
r			0.465229	-0.07143	0.018655	-0.35401	-0.35657	0.614202	-0.28812
t			2.16698	-0.29528	0.076928	-1.56068	-1.57361	3.209049	-1.24054
Result			S	NS	NS	NS	NS	S	NS

SMW-Standard Meteorological Week, S-Significant, NS-Non-significant *Significant at 5% level.

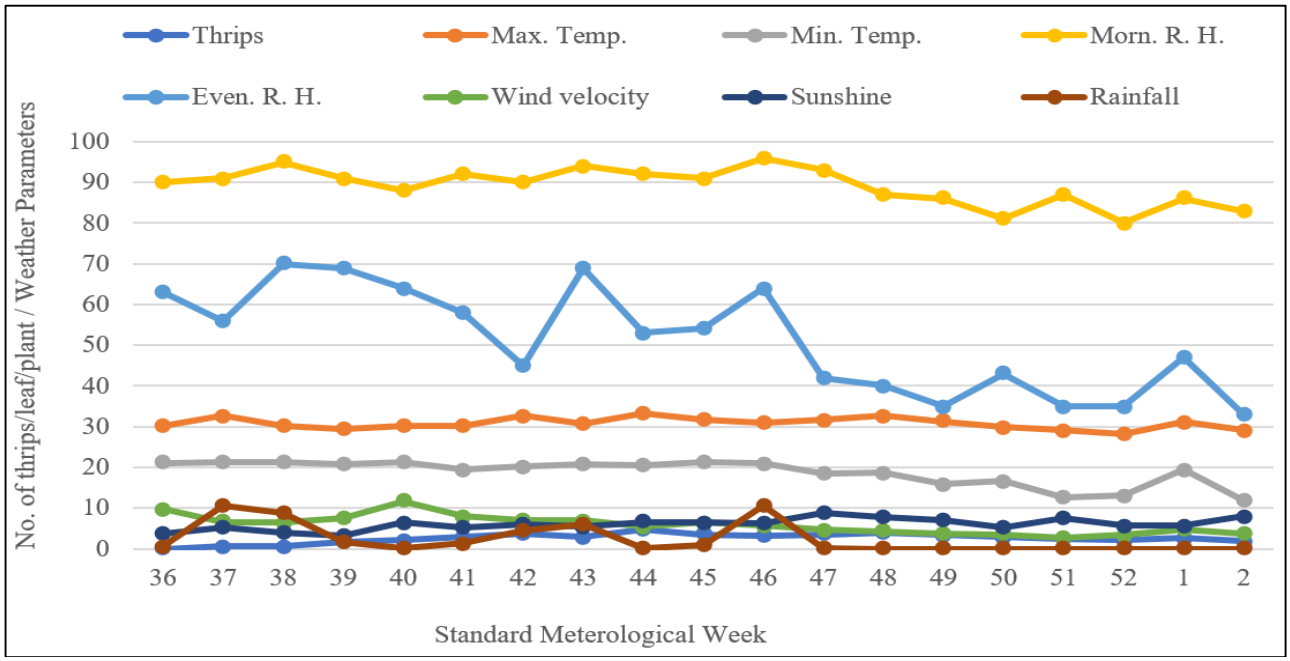

Fig 1: Seasonal incidence of thrips infesting chilli and their correlation with weather parameters during *kharif* season, 2024-25.

4. Conclusion

The analysis of weather parameters in the current study revealed significant positive correlations between the seasonal incidence of thrips and maximum temperature and sunshine hours during *kharif* 2024-25 at Baramati, with the infestation initiating in the 37th Standard Meteorological Week (SMW; second week of September) at an average of 0.67 thrips/leaf/plant. The thrips population progressively increased, attaining a primary peak of 4.67 thrips/leaf/plant in the 44th SMW (first week of November) and a secondary peak of 3.93 thrips/leaf/plant in the 48th SMW (first week of December), driven by optimal thermal and photoperiodic

conditions. Subsequently, a decline to 1.84 thrips/leaf/plant was observed in the 2nd SMW (second week of January 2025), attributable to decreasing maximum and minimum temperatures. Non-significant negative correlations with evening relative humidity, wind velocity and rainfall, alongside a non-significant positive correlation with morning relative humidity, further modulated this decline. These findings elucidate the critical influence of climatic factors on thrips proliferation, enabling the identification of vulnerable stages for targeted pest management. The study advocates for the integration of biological control measures, leveraging natural enemies, and minimizing the use of synthetic pesticides to preserve soil and environmental integrity, with the ultimate motto of fostering sustainable chilli production and ecological balance.

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