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Effect of agroclimatic parameters on seasonal incidence of thrips, *Thrips palmi* (Karny) on potato

Roopam Kunwar, Chenesh Patel, RM Srivastava, Khanika Pal and Anil Rana

Roopam Kunwar
Department of Entomology, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Chenesh Patel
Department of Entomology, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

RM Srivastava
Department of Entomology, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Khanika Pal
Department of Entomology, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Anil Rana
Department of Entomology, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Corresponding Author:
Roopam Kunwar
Department of Entomology, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Abstract
The current study was carried out at the Vegetable Research Centre of GBPUA&T, Pantnagar, during the *Rabi* season of 2020-21, on the seasonal dynamics of thrips (*Thrips palmi*) on potato (cv. Kufri Surya). Thrips populations were initially noted in the 46th Standard Week, with a population density of 4.33 thrips per plant, and peaked during the 48th SW (10.63 thrips per plant) and 49th SW (10.63 thrips per plant) (12.40 thrips per plant). Correlation research revealed that maximum temperature has a positive relationship with thrips population; however relative humidity (maximum and minimum) has a negative relationship. The key weather elements analysed collectively generated a 74.8 per cent variation in the thrips population (R^2 value). Understanding these periodic variations should help potato farmers plan their IPM tactics and move away from calendar-based pesticide use.

Keywords: Population, potato, seasonal incidence, thrips, meteorological parameters

Introduction
The potato (*Solanum tuberosum* L.) is cultivated in several regions of India under a variety of agroclimatic conditions as an early cash crop that sells for 70-80 per cent more money. (Bhatnagar *et al*., 2011) [1]. However, this crop's productivity is impeded by a variety of biotic and abiotic causes. Thrips, *Thrips palmi* Karny, is the most significant (Bhatnagar, 2007a) [2], transmitting GBNV (Groundnut Bud Necrosis Virus) and causes Stem Necrosis Disease in early potato. A widespread and significant insect known as thrips attacks weeds, flowers, trees, as well as numerous field and vegetable crops (Kawari, 1986) [3]. The pests exhibit diverse patterns in their prevalence, incidence, nature, and level of crop losses due to the wide diversity in distinct agro-climatic conditions of various locations. Because thrips feed by sucking and rasping the flowing cell sap, both their nymphs and adults cause the typical upward curling of leaves. The plants that were damaged are stunted and may eventually dry up (Zainab *et al*., 2016) [4]. Depending on the weather, thrips can destroy an early potato crop by 20–60%. In India the occurrence of thrips is anticipated to rise due to the rising temperatures brought on by climate change (Bhatnagar *et al*., 2014) [5]. Stem necrosis disease transmission is primarily to blame for the yield loss caused by thrips (Bhatnagar, 2007b [6], Bhatnagar and Thakur, 2008) [7]. Temperature and humidity are crucial factors in the growth of the vector population and subsequent disease development in early potatoes caused by the spread of GBNV (Groundnut Bud Necrosis Virus) (Bhatnagar, 2011; Bhatnagar *et al*., 2011) [8, 1]. Integrative pest control is built on an understanding of pest population dynamics. Crop growers can time samples to coincide with important pest life phases by understanding the seasonal dynamics of pests (Pedigo and Rice, 2016) [9]. Having a firm grasp on seasonal pest dynamics also helps farmers make smarter use of pesticides and other management strategies, maximising profits while minimising detrimental effects on the environment (Nietschke *et al*., 2007) [10]. In addition, IPM strategies can reduce the requirement for additional insecticide applications if implemented at the right times relative to critical stages of pest development (Herms, 2004) [11]. Therefore, the current study was done to examine the dynamics of thrips populations in connection to different weather conditions, with the hope that doing so would aid in determining the best time to implement pest management measures.

Methods and Materials
The present research took place during the *Rabi* season of 2020-21 at the Vegetable Research Center of the GB Pant University of Agriculture and Technology, Pantnagar-263145, Udham

Singh Nagar, Uttarakhand. In order to study the seasonal occurrence of thrips as well as the impact of current weather circumstances on its population trends, the potato variety "kufri Surya" was planted in a field with a plot size of 4.0m X 5.0m each and with a total of six replications. The experiment was conducted in a pesticide free environment. The collection of thrips incidence data was done at weekly intervals. Ten plants per plot were jarred (Bhatnagar *et al*., 2017) [12] into the blue sticky traps to count the number of thrips during a weekly period. Weekly meteorological data from Pantnagar Department of Agrometeorology including temperatures maximum and minimum, relative humidity morning and evening, sun-light hours, evaporation and wind speed, were gathered during the trial. To assess the relevation of weather on the variation in thrips population, correlation studies between the incidence of thrips population and significant meteorological factors were conducted using SPSS, Version 20, SPSS, Inc. Chicago, II, USA and Pearson correlation.

Results and Discussion

The thrips population was initially seen in the 46th Standard Week, i.e. the third week of November, with a population density of 4.33 thrips/Plant, and persisted until the 05th SMW (Table 1). The maximum and minimum recorded temperature were 28.5 °C and 11.3 °C, respectively, and the morning and night-time relative humidity levels were 92% and 36%, respectively. The thrips population climbed consistently as crop growth progressed, peaking on the 49th SMW on potato (12.40 thrips/plant). Peak thrips populations on potato crops varied (two peaks). The population peaked for the first time on potato during the 48th SW (10.63 thrips/plant). Similarly, the second high (12.40 thrips/plant) was found during the 49th SW. Pathipati *et al.* (2014) [13], on the opposite, detected a high thrips incidence during the last week of December. While Patel *et al.* (2009) [14] found the highest thrips occurrence in November.

Table 1: Seasonal Incidence of *Thrips palmi* on potato crop during the year 2020-21

Standard Weeks	Mean thrips counts/plant	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Sunshine (hrs.)	Wind velocity (km/hr.)	Evap. (mm)
		Max.	Min.	Morning	Evening				
46	4.33	28.5	11.3	92	36	0.0	8.1	1.9	3.0
47	8.23	25.1	8.7	93	43	0.0	7.5	2.2	2.9
48	10.63	25.0	8.6	94	42	0.0	6.1	1.0	2.2
49	12.40	25.7	10.1	94	50	0.0	6.4	1.3	2.7
50	7.02	20.8	9.7	93	67	2.5	3.3	3.4	1.7
51	3.44	16.0	4.1	95	65	0.0	3.1	2.5	1.0
52	1.86	20.8	4.1	96	55	0.0	5.4	1.9	1.5
01	2.16	20.3	9.2	94	62	18.6	3.1	2.8	2.1
02	0.60	18.7	8.7	97	72	0.0	3.9	5.6	2.0
03	0.80	18.2	7.5	96	69	0.0	3.7	2.7	1.7
04	0.82	16.6	8.8	96	75	0.0	1.6	2.8	1.5
05	0.55	18.8	6.1	96	61	0.0	4.5	1.1	1.8

Correlation analysis revealed that the thrips population showed a negatively and significant correlation with morning (r= -0.64*) and evening (r= -0.63*) relative humidity on potato, in agreement with observations by Subba and Ghosh (2016) [15] and Zainab *et al.* (2016) [4] (Table 2). Maximum temperature was found to have a significantly positive correlation with the thrips population (r= 0.70*), as observed by Zainab *et al*. (2016) [4]. There was no statistically significant relationship found between the potato thrips population and factors such as minimum temperature, rainfall, sunshine hours, evaporation, or wind speed. Our research, which agrees with that of Bhatnagar *et al.* (2011) [1], also found no statistically significant relationship between the sunshine hours and the number of thrips.

Table 2: Pearson's correlation matrix between weather observations and *T. palmi* population on potato during *Rabi* 2020-2021

Variables	PTh	Tmax	Tmin	RHmax	RHmin	Rf	SS	WV
Tmax	0.70*							
Tmin	NS	0.60*						
RHmax.	-0.64*	-0.76**	-0.58*					
RHmin.	-0.63*	-0.92**	NS	0.71*				
Rf	NS	NS	NS	NS	NS			
SS	NS	0.91**	NS	-0.58*	-0.94**	NS		
WV	NS	NS	NS	NS	0.62*	NS	NS	
Evap.	NS	0.90**	0.74**	-0.64*	-0.75**	NS	0.82**	NS

PTh: thrips population per plant; Tmax. and Tmin.: maximum and minimum temperature (°C); Tmin.; RHmin. and RHmax.: minimum and maximum relative humidity (%); Rf: rainfall in mm; SS: sunshine hrs.; WV: wind velocity in Km/h and Evap.: evaporation in mm. Bold numerals depicts the correlation data; data accompanied by a '*' indicate a statistically significant relationship at the $p < 0.05$ level; data followed by a '**' indicate a statistically significant relationship at $p < 0.01$; NS: non-significant

The population of *Thrips palmi* on potatoes was significantly influenced with weather variables, including maximum (Tmax) and minimum (Tmin) temperature, morning (RHmor) and evening (RHeve) relative humidity, rainfall (Rf), wind speed (WV), sunshine hours (SS), and evaporation (Evap) with reasonable accuracy of 74.8 per cent (R^2= 0.748) as shown by the regression equation.

Potato thrips = 102.709 + 3.934 Tmax – 4.387 Tmin – 1.474 RHmor + 0.073 RHeve – 0.669 Rf – 9.020 SS + 0.526 WV + 15.691 Evap

Conclusion

Weather conditions such as temperature have a significant impact on the seasonal prevalence of thrips. Thus, such variables play an important role in thrips infestation and spread, meaning that they can be used to effectively manage pest populations. Thus, understanding the abiotic elements influencing an insect pest's population is essential for developing a dependable and efficient management approach for a given pest.

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