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Tobacco Thrips, *Thrips Parvispinus* karny (Thripidae: Thysanoptera) incurred bell pepper fruit loss assessment in farmers' fields in Chitwan, Nepal

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Abstract

Bell pepper (*Capsicum annuum* L.), a highly marketable and remunerative vegetable crop, has faced severe infestation by the invasive tobacco thrips (*Thrips parvispinus* Karny) in the Chitwan district of Nepal. This study assesses plant damage and fruit losses caused by *T. parvispinus* in farmers' fields. The thrips were observed inflicting significant harm by sucking sap from leaves, buds, flowers, and fruits, leading to deformed, discolored leaves and malformed, undersized fruits. Field assessments were conducted in five randomly selected bell pepper farms, with data collected from five spots per field, each comprising three plants. Thrips population density and associated crop damage were recorded between January and April 2024. The infestation of *T. parvispinus* was highest in January, with thrips populations ranging from 15.7 ± 1.7 to 20.1 ± 1.6 per flower. A decline in thrips numbers was observed in February and March, attributed to insecticide applications by farmers. However, despite these efforts, fruit damage was highest in February, with damage levels ranging from 61.6 ± 10.4% to 80.0 ± 10.3% per plant. The insecticides used by farmers were found to be ineffective in mitigating yield losses, which emphasizes the need for effective pest management strategies to combat *T. parvispinus* infestations and reduce the economic losses faced by bell pepper farmers.

Keywords: Bell pepper, damage, fruit loss, infestation, *Thrips parvispinus*

Introduction

Bell pepper (*Capsicum annuum* L.), commonly known as sweet pepper or capsicum, is globally, one of the most widely cultivated and economically valuable vegetable crops (Sunitha and Narasamma, 2018) [1], and is equally a popular vegetable crop in Nepal (MoALD, 2024) [2]. Bell pepper is commercially grown in 1,931 ha of land, producing 20,002 mt with a productivity of 10.36 mt/ha in Nepal (MoALD, 2023) [3]. Despite its profitability, bell pepper cultivation is increasingly threatened by a range of insect pests. Over 35 insect and mite species, especially aphids, mites, and thrips (Sunitha, 2007) [4] have been identified worldwide as pests of peppers (Sorensen, 2005) [5]. However, Joshi *et al.* (2024) [6] recently identified and reported an invasive thrips, *Thrips parvispinus* (Karny) (tobacco thrips or black thrips) in 2024, causing a local outbreak in different bell pepper cultivated field in Chitwan district.

Thrips parvispinus is a polyphagous pest with a broad host range, attacking a variety of agricultural and ornamental crops such as bell peppers, chilies, eggplants, and papaya. The thrips damages plants by feeding on leaves, buds, flowers, and fruits, resulting in deformities, discoloration, and reduced marketability in fruits. Typical symptoms of *T. parvispinus* infestation in peppers include papery and distorted leaves, premature leaf drop, curling of young leaves, and cork-like scars on fruits and foliage (Pijnakker, 2023) [7]. Such damage significantly reduces the economic value of the crop, with yield losses reported to range from 23% to 60% in Indonesia (Johari *et al*., 2014) [8] and 40% to 80% in India (DPPQS, 2022; Thorat *et al*., 2022) [9, 10]. Since its first detection in India in 2015,

T. parvispinus has spread from southern regions to central and northern states (Varma Nalla and MC, 2023) [11]. Moreover, in addition, the pest exacerbates losses in the bell pepper crop by serving as a vector for Tobacco streak virus-Ageratum strain (TSV-Ag) (Pijnakker, 2023) [7]. Despite the availability of various insecticides, managing *T. parvispinus* populations remains challenging, often forcing farmers to abandon crops altogether (Sridhar *et al*., 2021) [12].

Despite the increasing prevalence of *T. parvispinus* in Nepal, research on its impact on the quality and yield in bell pepper remains limited. This study aims to quantify the economic losses caused by *T. parvispinus* in bell pepper cultivation in Chitwan, Nepal.

Materials and Methods

Study area and sampling design

During the second week of December 2024, bell pepper farmers in the eastern part of Chitwan district, Nepal, reported a severe infestation of the tobacco thrips, *T. parvispinus* on the flowers and fruits of their crops. To assess the extent of thrips incurred infestation and damage in the crop, a survey was conducted across five thrips-infested bell pepper fields in Chitwan district from January to April 2024 (Figure 1). The selected fields and their geographical details are presented in Table 1.

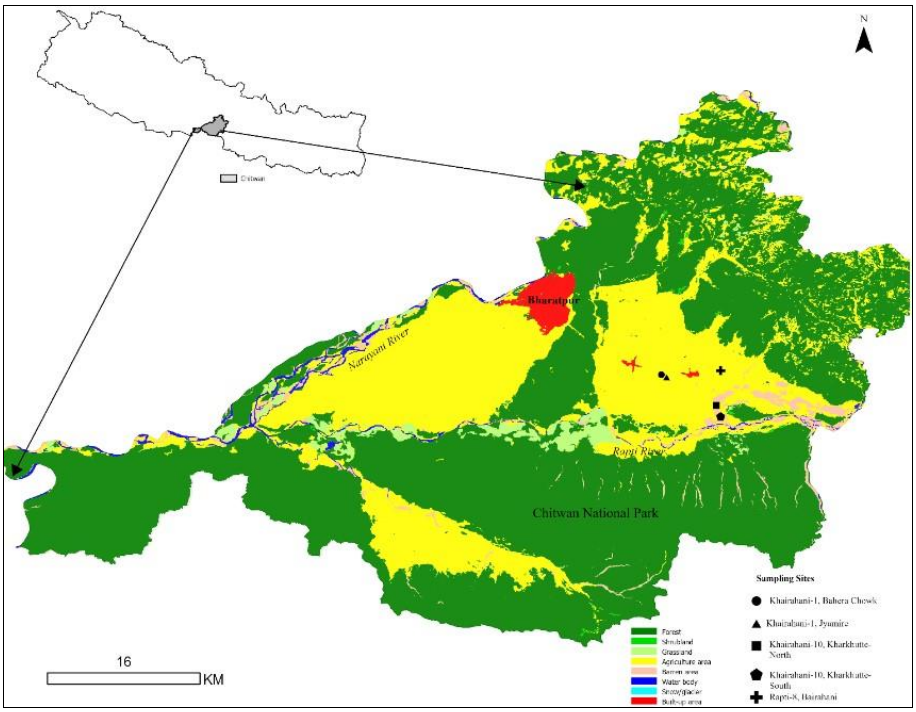

Fig 1: Location of bell pepper farms in Chitwan district

Table 1: Location detail of bell pepper farms in Chitwan district selected for the damage assessment due to *T. parvispinus*

Farm location	GPS Coordinates	Elevation (masl)
Khairahani-1, Jyamire	27.610"N, 84.548"E	198.6
Khairahani-1, Bahera Chowk	27.612"N, 84.543"E	191.7
Khairahani-10, Kharkhutte-North	27.583"N, 84.595"E	188.0
Khairahani-10, Kharkhutte-South	27.573"N, 84.599"E	197.3
Rapti-8, Bairahani	27.616"N, 84.599"E	216.7

In each of the selected fields, five sampling spots were chosen randomly, following the method described by DPPQS (2022) [9]. These spots included four locations at the corners of the field (at least 1.5 m inside the field borders) and one spot at the center (Figure 2). Three bell pepper plants were randomly selected at each sampling spot for data generation on thrips population and its damage.

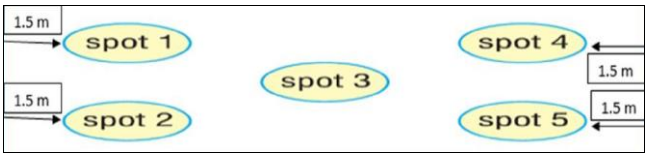

Fig 2: Thrips sampling within a farmer's bell pepper field

Damage assessment

Infested plant parts (flowers and fruits) were visually examined at monthly intervals from January to April 2024 to record thrips abundance and damage in crop. The population of thrips was assessed by counting the number of thrips per sample, while the extent of fruit damage was derived in percentage from the sampled plants.

Weather data

The prevailing meteorological data during the entire research period, January to April 2024, is shown in Table 2. National Maize Research Program, Rampur, Chitwan is the source of meteorological data.

Table 2: Meteorological data of Chitwan district from January to April 2024 from National Maize Research Program, Rampur, Chitwan

Month	Average maximum temperature (℃)	Average minimum temperature (℃)	Average rainfall (mm)
January	25.05	10.13	0.00
February	25.44	10.63	0.00
March	30.67	17.27	8.13
April	37.49	22.69	0.00

Data Analysis

Descriptive statistics on the thrips abundance and the fruit infestation percentage were generated using Microsoft Excel.

Results and Discussion

Average number of flowers per plant, thrips population and feeding behavior

The average number of flowers per bell pepper plant was highest in January (4.40 ± 0.75 to 6.93 ± 1.11 flowers per plant) and declined significantly in February (1.87 ± 0.38 to 2.87 ± 0.41 flowers per plant) and March (1.47 ± 0.29 to 2.47 ± 0.48 flowers per plant) (Table 3). This decline coincided with severe infestations, which caused flower drop and deformation.

Table 3: Average number of flowers in bell pepper (N = 15) in Chitwan, 2024

Farm location	Average number of flowers per Plant ± SE		
	January	Febuary	March
Khairahani-1, Jyamire	6.93 ± 1.11	2.07 ± 0.41	1.47 ± 0.29
Khairahani-1, Bahera Chowk	5.40 ± 0.77	1.87 ± 0.38	1.53 ± 0.31
Khairahani-10, Kharkhutte-North	5.27 ± 0.87	2.34 ± 0.43	1.47 ± 0.51
Khairahani-10, Kharkhutte-South	4.67 ± 0.76	2.53 ± 0.43	2.47 ± 0.48
Rapti-8, Bairahani	4.40 ± 0.75	2.87 ± 0.41	1.67 ± 0.42

SE= Standard Error of mean

Symptoms observed in infested bell pepper plants were papery leaves, crinkling and upward curling of leaves, distortion such as cork like symptoms on leaves and fruits (Figure 3). Similar findings by Pijnakker (2023) [7] indicated that *T. parvispinus* fed and reproduced on young leaves and flowers, causing papery and distorted leaves, cork-like scarring on fruits, and flower drop. Adults and nymphs thrips were predominantly found on flowers during the day, shifting to leaves at night (Vos *et al*., 1991) [13]. *T. parvispinus* showed a preference for white, fragrant flowers (Mound and Collins, 2000) [14], making bell pepper flowers a highly suitable host.

Fig 3: Symptoms observed in thrips infested bell pepper plants: a) papery and distorted leaf, b) cork like symptoms on fruits, and c) distorted fruit

Thrips infestation levels

The highest thrips infestation was recorded in January, with an average of 15.67 ± 1.67 to 20.07 ± 1.62 thrips per flower (Figures 4 and 5). High abundance of thrips may be attributed to the favorable environmental conditions, particularly temperatures between 25.05 °C (maximum) and 10.13 °C (minimum) (Table 2), which are optimal for thrips reproduction and survival (Hutasoit *et al*., 2017; Hulagappa *et al*., 2022) [15, 16]. Hutasoit *et al*. (2017) [15] and Hulagappa *et al*. (2022) [16] also recorded the temperature range of 25 to 27 °C for the maximum reproduction and survival potential of *T. parvispinus* in Indonesia. Similar finding of the highest level of infestation, 10 to 20 thrips per flower, was reported by DPPQS (2021) [17] and Hulagappa *et al*. (2022) [16]. The infestation decreased significantly in February (3.10 ± 0.70 to 4.94 ± 0.83 thrips per flower) and March (0.27 ± 0.12 to 1.20 ± 0.30 thrips per flower) that were likely due to effect of applications of insecticides in the bell peppers by farmers. However, as noted by Kirk (1997) [18], insecticides can also eliminate natural predators, potentially impacting long-term pest control.

Fig 4: Thrips, *Thrips parvispinus* infested flower in bell pepper field in Chitwan, Nepal

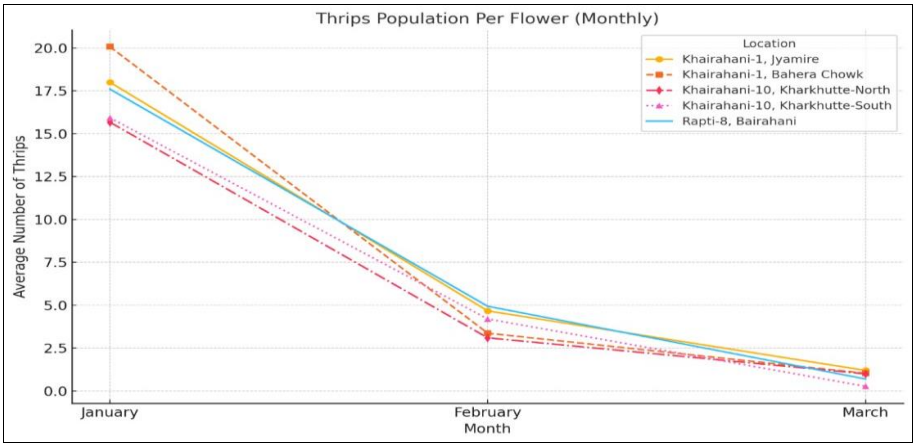

Fig 5: The average number of thrips per flower for each location across January-March, 2024

Fruit damage percentage

The average number of fruits per bell pepper plant were also recorded to calculate thrips damage, expressed as the percentage of thrips damaged fruits on the sample plants. The average number of fruits per bell pepper plant was highest in January (4.82 ± 0.84 to 6.00 ± 0.89 fruits per plant) (Table 4).

Table 4: Average number of fruits in bell pepper plants (N = 15) in Chitwan, 2024

Farm location	Average number (± SE) of damaged fruits per plant		
	January	February	March
Khairahani-1, Jyamire	6.00 ± 0.89	4.00 ± 0.69	2.47 ± 0.46
Khairahani-1, Bahera Chowk	5.47 ± 0.96	3.53 ± 0.75	3.00 ± 0.53
Khairahani-10, Kharkhutte-North	5.53 ± 0.95	3.07 ± 0.62	2.20 ± 0.50
Khairahani-10, Kharkhutte-South	5.47 ± 0.89	4.00 ± 0.74	3.93 ± 0.72
Rapti-8, Bairahani	4.82 ± 0.84	4.07 ± 0.81	2.47 ± 0.49

SE= Standard Error of mean

Severe infestation by *T. parvispinus* resulted in deformed fruits with cork-like scarring, scratchy surfaces, and abnormal shapes. The highest fruit damage percentage was recorded in February (61.64 ± 10.35 to 80.00 ± 10.33) (Table 5) corresponding to peak thrips activity in January. These results align with findings by Thorat *et al*. (2022) [10], who reported 40-80% crop losses in India due to *T. parvispinus*. Multiple studies have reported that infestation by *T. parvispinus* cause heavy flower drop, resulting in reduced fruit production. *T. parvispinus* infestation resulted to significant flower drop and ultimately fruit yield reduction (Thorat *et al*., 2022) [10], and also affected fruit set through the drying and withering of flowers (Pijnakker, 2023) [7].

Table 5: Average fruit damage percentage by thrips, *T. parvispinus* per bell pepper plant (N = 15) in Chitwan, 2024

Farm location	plant	Average fruit damage percentage (±SE) per bell pepper	
	January	February	March
Khairahani-1, Jyamire	64.94 ± 6.07	75.41 ± 7.67	55.92 ± 9.09
Khairahani-1, Bahera Chowk	63.72 ± 7.69	80.00 ± 10.33	77.55 ± 10.14
Khairahani-10, Kharkhutte-North	61.79 ± 9.59	64.38 ± 7.25	46.11 ± 10.19
Khairahani-10, Kharkhutte-South	56.21 ± 7.32	72.77 ± 9.65	35.82 ± 6.43
Rapti-8, Bairahani	59.56 ± 8.10	61.64 ± 10.35	42.67 ± 9.44

SE= Standard Error of mean

Conclusions

This study was conducted in 2024 to assess the damage caused by *T. parvispinus* on bell pepper crops in Chitwan, Nepal. Key parameters observed included the average number of flowers per plant, thrips abundance per flower, number of fruits per plant, and percentage of fruit damage. The findings revealed that *T. parvispinus* infestation peaked in January, with thrips populations ranging from 15.67 ± 1.67 to 20.07 ± 1.62 per flower. The highest fruit damage percentage was recorded in February, ranging from 61.64 ± 10.35 to 80.00 ± 10.33 per plant. Regardless of the use of various pesticides by farmers for *T. parvispinus* management, significant economic losses in bell pepper yield were observed in Chitwan district, caused by decrease in flower number, premature flower drop, fruit distortion, and reduced marketability. Therefore, this study emphasizes the need for effective integrated pest management strategies for minimizing the damage caused by *T. parvispinus* for sustainable bell pepper production.

Acknowledgements

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