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EVALUATING DIFFERENT PHEROMONE TRAPS FOR TOMATO LEAF MINER (*Tuta absoluta* MEYRICK) IN KATHMANDU VALLEY

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ABSTRACT

This study was conducted in plastic tunnel farms located in Gamcha and Jhaukhel in Bhaktapur, Lubhu in Lalitpur, and Machhegaun in Kirtipur. The research spanned from April to the first week of August 2023. The primary aim of this study was to assess the effectiveness of various pheromone traps (Light trap, Wota-t trap, and delta trap) in controlling Tuta absoluta in the specified locations. Experiments were conducted using these traps, each equipped with a Tomato leaf miner lure, and the captured Tuta moths were tallied and recorded every week for a total of 16 weeks. The results consistently demonstrated the superior performance of the Wota-t trap in terms of capturing Tuta moths in all locations, except for Lubhu, where the Light trap proved to be more effective. In contrast, the delta trap consistently yielded fewer Tuta catches compared to the other two traps during each field visit. Results showed that Wota-t traps were significantly efficient in closed environments with high Tuta populations and had the advantage of capturing very few non-targeted pests, while light traps were consistently effective, but they had the drawback of attracting non-targeted nocturnal pests. On the other hand, Delta traps consistently yielded poor results, with significantly fewer Tuta captures. In light of these findings, this research recommends that tomato farmers in Kathmandu Valley who cultivate their crops in tunnel farms should use Wota-t traps for enhanced control of Tuta absoluta infestations.

Key Words: Tomato, *Tuta absoluta*, Wota-t trap, light trap, delta traps

INTRODUCTION

In Nepal the agricultural sector contributes about 24.12 percent of the national GDP (NRB, 2023). Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crops in Nepal, with considerable potential for income and employment opportunities. In terms of area and output, tomato ranks third after

cauliflower and cabbage in Nepal. It is cultivated in about 20,000 hectares (ha) and around 0.3 million MT of tomato is produced annually in the country (MoAD, 2014). However, its productivity in Nepal is 19.3 MT per ha, (MoAD, 2015/16) which is far below worldwide production of 37.46 MT per ha. (FAOSTAT Database, 2016). The highest marketable yield was recorded from a hybrid all-rounder (86.6 t/ha) followed by Srijana (80.8 t/ha) in Nepal under a high tunnel (Chapagain et al., 2011). Potential production of this crop is limited by several biotic and abiotic factors such as early and late blight, tomato fruit borer, tomato leaf miner etc. Among them, recently, the South American Tomato Leaf Miner (TLM) *Tuta absoluta* (Lepidoptera: Gelechiidae) has emerged as one of the devastating pests of tomato crops all over the world (Tosevski et al., 2011). The pest has appeared as a havoc causing a significantly crop loss in Nepal. This pest was recorded for the first time in Nepal in the Kathmandu Valley during May, 2016 and found spread into tomato growing areas near Kathmandu Valley and surrounding districts; Kavrepalanchowk, Dhading and Nuwakot (Bajracharhya et al., 2016).

MATERIALS AND METHODS

Experimental location

Kathmandu, Lalitpur and Bhaktapur districts were selected as research sites for the study. The experiment was conducted in the fields of four tomato farmers to monitor and evaluate the best traps to capture the *Tuta absoluta* in field. The weather in Kathmandu Valley is warm and is a temperate zone with a mild climate. The average annual temperature and annual rainfall of Kathmandu valley is 17.78˚C and 1343 mm, respectively.

Weather of the study sites

Weather data such as temperature (maximum and minimum) and precipitation were collected from April to July from the Department of Hydrology and Meteorology (DHM), Babar Mahal, Kathmandu. The maximum and minimum temperature and average precipitation of Gamcha are 35.5 ˚C, 6.4 ˚C and 5.62 mm, respectively. The maximum and minimum temperature and average precipitation of Jhaukhel are 32.2 ˚C, 8 ˚C and 7.29 mm respectively. The maximum and minimum temperature of Lubhu is 32.2˚C, 4.4˚C and 5.02 mm respectively. The maximum and minimum temperature and average precipitation of Kirtipur are 31.9 ˚C, 7.1 ˚C and 5.38 mm, respectively.

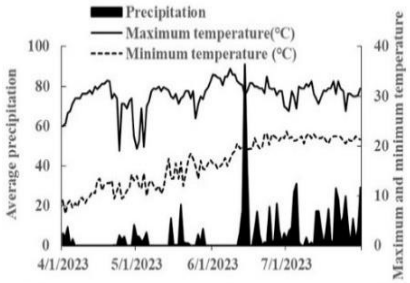

Figure 2: Graph showing maximum and minimum temperature (°C) and average precipitation (mm) of Gamcha during study period of 2023

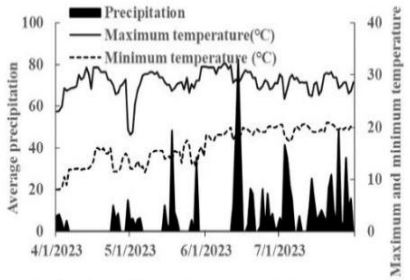

Figure 3: Graph showing maximum and minimum temperature (°C) and average precipitation (mm) of Jhaukhel during study period of 2023

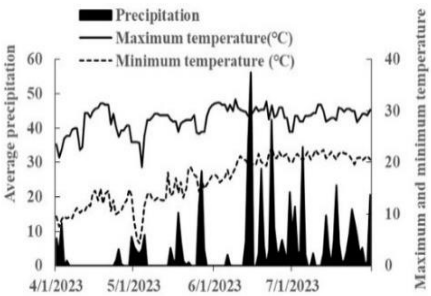

Figure 4: Graph showing maximum and minimum temperature (°C) and average precipitation (mm) of Lubhu during study period 2023

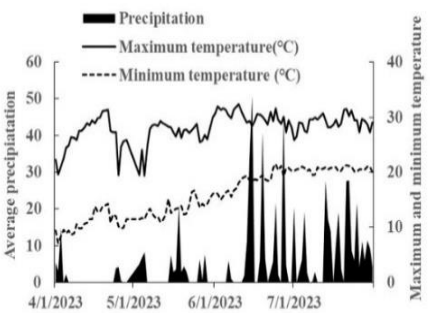

Figure 5: Graph showing maximum and minimum temperature (°C) and average precipitation (mm) of Kirtipur during study period 2023

Experimental Design

The experiment was done in four different locations consisting of three treatments.

Table 1. Treatments used in experimental location

S.N.	Location	Treatment
1.	Gamcha, Bhaktapur	Wota-t trap, Light trap, Delta trap
2.	Jhaukhel, Bhaktapur	Wota-t trap, Light trap, Delta trap
3.	Lubhu, Lalitpur	Wota-t trap, Light trap, Delta trap
4.	Machhegaun, Kirtipur	Wota-t trap, Light trap, Delta trap

Trap installation

The traps were installed on 9th and 10th April, 2023 on Bhaktapur, 11th April, 2023 in Lubhu and 12th April, 2023 on Kirtipur. According to the crop growth stage the traps were fitted at different height i.e. 25 cm during trap set up on 9th April and raised to 45 cm on 7th May. The distance between each trap was 7±1 meter. Soap

water solution added to light and wota-t trap and was also replaced after counting the moth population at weekly interval. Delta trap was changed every 14-days interval. The TLM lure was fitted in each trap and was changed at one month interval.

Data collection

The primary data was collected directly from the field at weekly intervals. The moths attracted to the different treatments in different locations were counted and recorded for further analysis. The delta trap was changed on fortnightly and lures was changed once a month.

Statistical analysis

The collected information was compiled systematically and chronologically. The data was analyzed by using Microsoft Excel and SPSS (Statistical Package for the Social Sciences). The results were presented in the form of a bar diagram, graph, table etc.

RESULTS AND DISCUSSION

Evaluation of different traps

Average number of *Tuta absoluta* moths captured in different traps

The number of *Tuta* moths caught by different traps with *Tuta absoluta* sex pheromone lure in varied markedly in different locations of Kathmandu Valley. Wota-t trap was found as the most effective during most of the field visits. The efficacy of the Wota-t trap is unquestioned as per the data collected but the light traps were almost equally effective as it was more effective in trapping moths at Lubhu in total.

During the study period, the highest number of *Tuta* moths captured was observed in Lubhu, Lalitpur. In Lubhu, Lalitpur, monocropping of tomato was a common practice which larger area compared to other locations. If tomatoes are continuously grown in the same field without rotation, the pest population can build up over time. The recent invasion history in Afro-Eurasian and Middle Eastern countries implies that areas with large monocultures of tomato and/or that provide alternative hosts favor *T. absoluta* expansion (Biondi et al., 2018). In Gamcha and Jhaukhel Bhaktapur, a mixed cropping pattern was followed. Tomato and Cucurbits were cultivated under a plastic tunnel of the entire field. The average number of moths trapped in both places was almost similar and a higher number of moths were captured in wota-t trap. But in Machhegaun, Kirtipur the tomato cultivated area was less and nearby farms were cultivated with cucurbits,

so the number of moths trapped was relatively less. Nonetheless, the wota-t trap was found to be the most effective than other traps.

The finding of this study are in line with the research conducted by (Gautam et

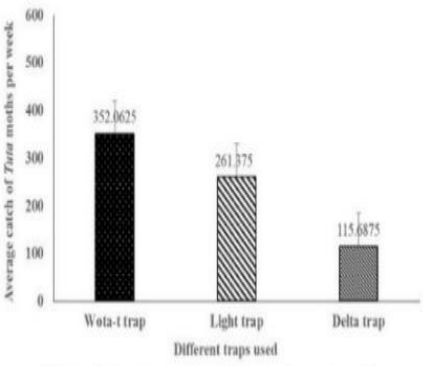

Figure 6: Average catch of *Tuta* moths captured in different traps in Gamcha, Bhaktapur

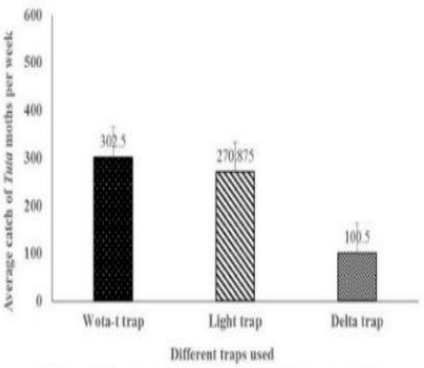

Figure 7: Average catch of *Tuta* moths captured in different traps in Jhaukhel, Bhaktapur

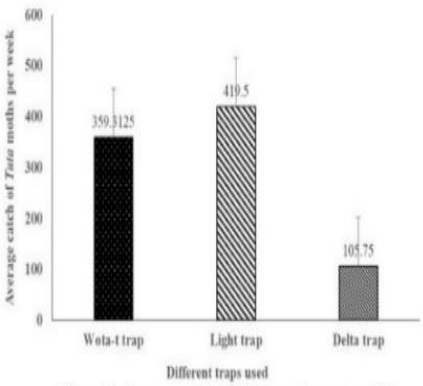

Figure 8: Average catch of *Tuta* moths captured in different traps in Lubhu, Lalitpur

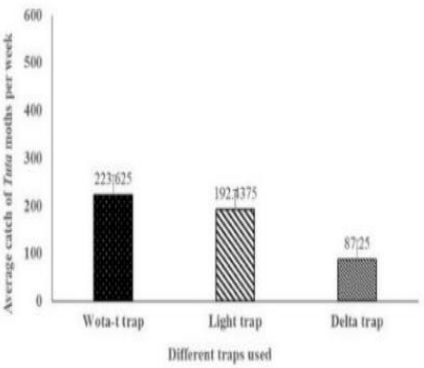

Figure 9: Average catch of *Tuta* moths captured in different traps in Machhegaun, Kirtipur

al., 2018), in Kavre district of Nepal, which is geographically very close to Kathmandu valley with similar climatic conditions. They found Wota-T trap as the most effective method for catching *Tuta absoluta* where trapped *Tuta* population ranged from 51-972 in each Wota-T trap.

Also, Adhikari et al. (2019) in the Kavre district found that para-pheromone TLM lures in Wota-t trap were mostly used by the tomato growers' farmers because of its effectiveness than other traps.

According to Arturo (Cocco et al., 2012) light traps are the most effective for controlling tomato leaf miner infestation over a larger area because they were found to catch more *Tuta* moths in both Winter-summer plantations as well as Summer-winter plantations and controlled the infestation over the leaves and stem of tomato effectively in the research done in Sassari, Italy.

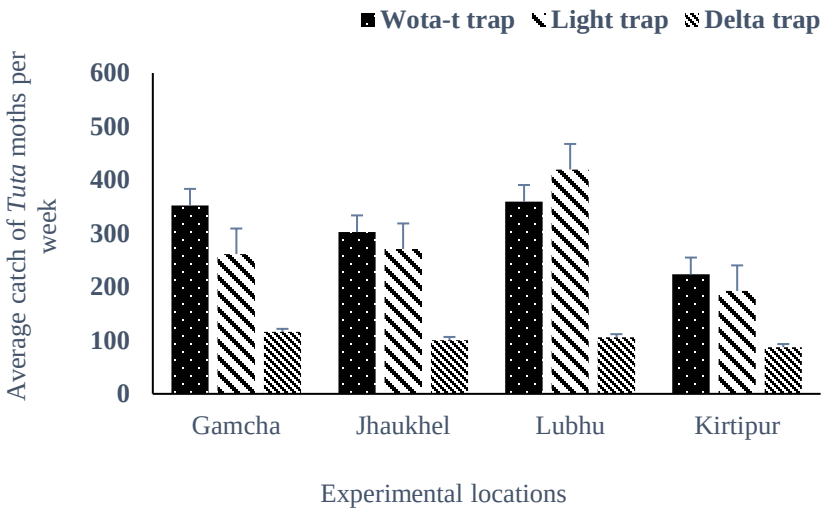

Figure 10. Average number of *Tuta absoluta* moths captured in different traps

Seasonal appearances of *Tuta absoluta* moths

Figure 11 shows the fluctuation of *Tuta* moth captured by the different traps (Wota-t trap, Light trap, Delta trap) in different months. The maximum number of *Tuta* moths captured by different traps were in the month of May and the minimum number of *Tuta* were captured in July. Wota-t, light and delta traps were dominant in the month of May. This result resembled a similar result of an experiment where fluctuation of the pest peaked during mid-June and decreased later on (AL- Sawy et al., 2016). It also shows that the population fluctuation of *T. absoluta* has two stages. The first stage was extended from April to May. It was characterized by an upsurge in the number of captured moths till the peak of the population on average was 729 moths per week. The second stage recorded a decline in the population from May to June. Again, from June to July saw a

gradual plunge in the population of *Tuta absoluta*. Figure 12 shows the fluctuation of *Tuta* moth captured by the different traps (Wota-t trap, Light trap, Delta trap) in different months. The maximum and minimum number of *Tuta* moths captured in wota-t trap (May and July), light trap (July and May) and delta trap (June and April). For the period between April to July, trends of moth catches were found very contrasting in wota, light and delta traps. In wota-t traps the moths population increases from April to May and gradually decrease from May to July. But in light trap there were a smaller number of moths caught in the months of April to May and then the population of moths were found gradually increased from May to July. Similarly, in the delta trap, there is a gradual increase of *Tuta* moths from April to June and again slight decrease during July.

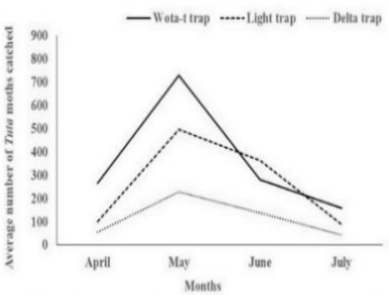

Figure 11: Seasonal appearance of *Tuta absoluta* moths captured on different months in Gamcha, Bhaktapur

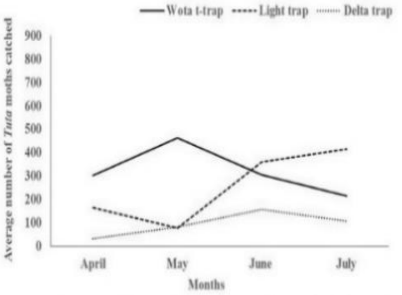

Figure 12: Seasonal appearance of *Tuta absoluta* moths captured on different months in Jhaukhel, Bhaktapur

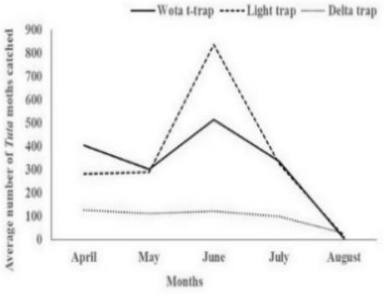

Figure 13: Seasonal appearance of *Tuta absoluta* moths captured on different months in Lubhu, Lalitpur

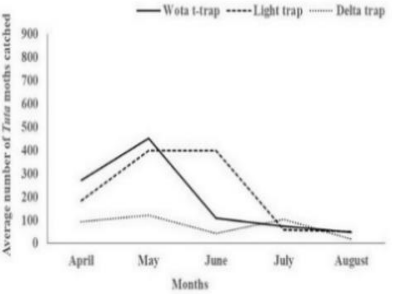

Figure 14: Seasonal appearance of *Tuta absoluta* moths captured on different months in Machhegaun, Kirtipur

Figure 13 shows the fluctuation of *Tuta* moth captured by the different traps (Wota-t trap, Light trap, Delta trap) at different months. Wota-t trap and Light trap caught maximum number of *Tuta* moths as compared to delta trap. The

maximum and minimum number of *Tuta* moths captured in wota-t trap (June and August), light trap (June and August), and delta trap (April and May). During the study period, the moths caught were less in the initial days of trap installation. Suddenly the number of moths catches increased from May to July. The study revealed that the highest average number of *Tuta* were captured in June i.e. 839.5 and the least number of moths caught in August i.e. 6

Figure 14 shows the fluctuation of *Tuta* moth captured by the different traps (Wota-t trap, Light trap, Delta trap) at different months in Machhegaun, Kirtipur. The maximum and minimum number of *Tuta* moths captured in wota-t trap (May and August), light trap (May to June and August) and delta trap (May and August). It shows that the traps caught a maximum number of moths during the initial days of trap installation in May. Later on, there was observed a sharp decline in the number of *Tuta* moths from June to August possibly because of the declining number of *Tuta* as a result of effective initial catch.

Chi-square test was done to find out the association between different types of traps with location. χ^2 calculated values| 442.612| > χ^2 tabulated values|22.46| where (P=0.001). From data analysis, a highly significant difference was recorded in the mean weekly observation. That implies there is a significant difference in the number of *Tuta* catches depending on the types of pheromones traps and the location where the traps have been placed.

CONCLUSION

The study showed that there are many insects pests of tomato in the field and among them, *Tuta absoluta* appeared to be the most challenging one among the tomato growing farmers. Nepalese farms, particularly tomato fields, are becoming a hotspot for *Tuta absoluta*, mostly because farmers are unaware of the indiscriminate use of pesticides, the presence of several months, as well as the season and suitable conditions for pest attacks. During the interval of 4-5 months, the number of *Tuta* moths captured in different seasons varies according to the location due to environmental factors and the cropping pattern.

Wota-t trap appeared to be the most attractive for monitoring *T. absoluta* moths and enhanced the effectiveness of pheromone-baited traps. Therefore, this trap can be used as one of the best pheromone-based management strategies for the management of *Tuta* moth.

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