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Research Article

MONITORING SOUTH AMERICAN TOMATO LEAF MINER, *TUTA ABSOLUTA* (MEYRICK) AND ASSESSMENT OF MANAGEMENT PRACTICES ADOPTED IN KAVRE, NEPAL

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ABSTRACT

The study was carried out from April-August, 2017 to monitor the population of *Tuta absoluta* and to assess the management practices being adopted in Kavre, Nepal. Study consisted of two major parts: monitoring of insect population and farmer's survey. The population of *T. absoluta* ranged from 51 to 972 in each Wota -T trap. The highest population of the insect in traps were recorded in Dhulikhel followed by Panauti and Banepa. Majority of tomato growers (78%) reported *T. absoluta* as the most problematic among other pests, diseases and disorders. The data from E-Plant clinic at Panchkhal revealed the degree of severity of *T. absoluta* in tomato crop. Tomato growers have adopted cultural, physical, mechanical, para-pheromone lures, quarantine, botanical and chemical methods for the management of this pest. Majority of them relied on chemical pesticide (94%) followed by cultural practices (86%) and Tomato Leaf Miner (TLM) lure (66%) based on cumulative percentage of respondents. Use of TLM lure was found as the best in terms of its effectiveness, safety, and practicability. Thus, Integrated Pest Management strategies are essential to limit the significant loss and reduce dependency on chemical pesticides in future.

Key words: E-plant clinic, monitoring, management, para-pheromone, Tuta absoluta

INTRODUCTION

The South American tomato leaf miner, *Tuta absoluta* (Meyrick) [Lepidoptera: Gelechiidae], is an invasive pest native to South America. It is a major threat to world's tomato production (Chidege *et al.*, 2016) in both open and greenhouse condition. It has become serious agricultural pest of tomatoes of South America, Europe, Middle East and some of the Asian countries (Desneux *et al.*, 2010). The main damage symptom of this pest is usually observed on the leaves and fruits, but inflorescences and stems are also affected.

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The damaged leaves turn yellow, wither, and senescence; the fruits are destroyed with consequent death of whole plant in case of severe attack (Maluf *et al.*,1997). Yield and fruit quality are both considerably affected by direct feeding as well as secondary pathogens entering into the host plants through wounds made by the pest (Kaoud, 2014).

It has been recently introduced to Nepal, with its first official record in May 2016 from the Kathmandu valley (Bajracharya *et al.,* 2016). Studies carried out by Nepal Agricultural Research Council (NARC) during 2016 confirmed the presence of this pest in 14 locations from five districts viz., Kathmandu, Lalitpur, Bhaktapur, Kavre and Dhading among which the highest level of infestation was observed from Ugrachandi Nala-2 and Panchkhal of Kavre (Plantwise, 2017). Tomato fruit imported in Nepal to fulfill the demand of Kathmandu valley from India could be probable source of its entry in Nepal (Bajracharya *et al.*, 2016). Tomato worth $7,200/ha was lost which amounts to 25-30% of total production where *T. absoluta* has been reported (Sah and Giri, 2017). In Nepal, the potential yield and financial loss due to this pest could reach upto 80-100% and $ 50 million per annum respectively (Poudel, 2017). Despite of its recent introduction, it has caused severe damage to crop resulting in huge amount of economic and ecological imbalances. The objective of this study was to monitor the population of *T. absoluta* and to assess its management practices being adopted by farmers in Kavre district.

MATERIALS AND METHODS

The study was conducted in Kavre district of Nepal during April-August, 2017. Major tomato growing areas viz. Panchkhal, Banepa, Panauti, Dhulikhel and Mandan Deupur were selected for monitoring of *T. absoluta* and farmer's survey. For field monitoring of this insect, three commercial tomato farms having plastic house of size 5*12 m^2 and cultivating Srijana variety were selected at Banepa, Dhulikhel and Panauti. Four Wota -T traps incorporated with para-pheromone lure (Karma Lure -8) were installed in each farm with a total of 12 Wota -T traps in three locations. Traps were set on June 2, 2017 when the tomato crop was around a month old. They were positioned inside tomato field about 30 cm above the ground in the beginning and its height was later on adjusted upto 1 m according to the increment of the height of tomato plant. The total number of *T. absoluta* adults recorded in traps from an experimental field was counted weekly for two months and para-pheromone lure was changed at every 15 days interval.

Fifty commercial tomato farmers (having age between 20 and 60 years) were selected purposively from Panchkhal, Banepa, Panauti, Dhulikhel and Mandan Deupur municipality for survey. Survey was carried out to find out the status of *T. absoluta* and management practices adopted by tomato growers in Kavre. Also, the information on the cases of *T. absoluta* was taken from regular e-plant clinic conducted at Panchkhal by District Agriculture Development Office (DADO), Kavre and CABI Plantwise Programme of Plant Protection Directorate, Hariharbhawan, Lalitpur.

Primary data were obtained from counting the number of *T. absoluta* from Wota-T traps, farmer's survey data collected through semi structured questionnaire and focus group discussion whereas secondary data were collected reviewing different published materials. Data were analyzed using MS excel and SPSS. On the basis of responded frequencies, different *T. absoluta* management practices were compared in terms effectiveness, economic, safeness, practicability and availability.

RESULTS AND DISSCUSSION

Monitoring *T. absoluta* using TLM lure

Based on weekly observation in three location of Kavre from June to August, the population of male moths trapped in a Wota-T trap with TLM lure ranged from 51 to 972. The maximum of 972 male moths per week were observed during June 22, 2017 in Dhulikhel whereas in Panauti and Banepa maximum number of moths recorded were 510 on August 2, 2017 and 292 in June 15, 2017 respectively. The population of male moth has reached its peak during June and remarkably low population during July which again increased during August (Figure1). Similar findings were obtained in Albania that four generation of *T. absoluta* was found during summer season, 1st generation appears in ten days of March, reaches maximum on April 4 and finish at April 8; 2nd generation appears at April 18 reaches maximum at May 9 and finish at May 14: 3rd start at May 23, reaches maximum at June 13 and finish at June 18; 4th starts at June 27, reaches maximum at July 18 and finish at July 25 (Berxolli and Shahini, 2017).

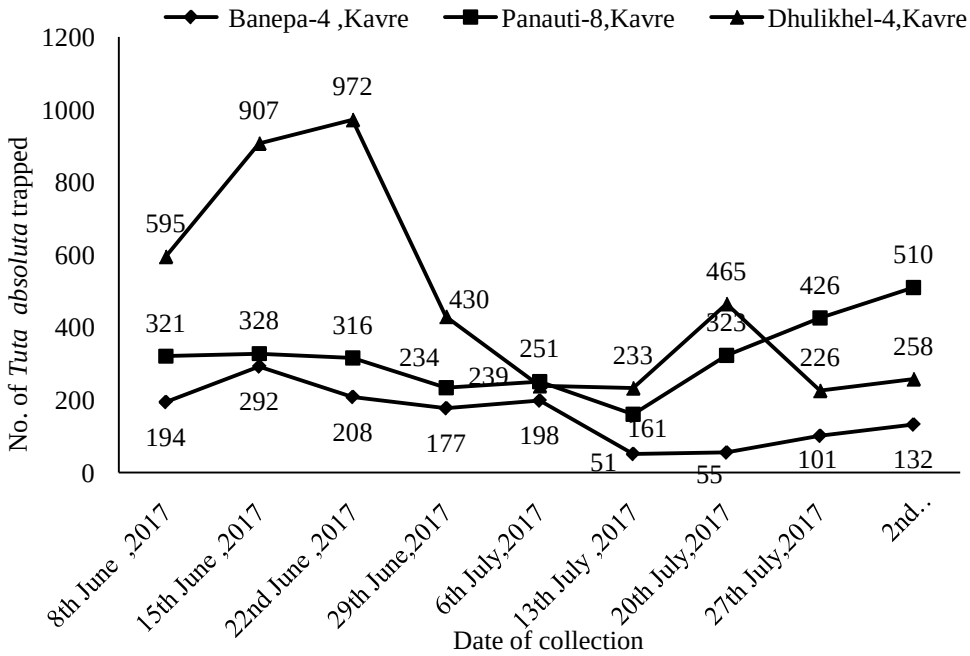


Fig.1 : Population of *T. absoluta* trapped in three locations of Kavre, 2017

During monitoring period, the number of *T. absoluta* trapped were 4325 in Dhulikhel, 2870 in Panauti and 1480 in Banepa (Figure 2). The lower number of the pest in Banepa as compared to other two places during the same counting period might be due to the use of insecticide (Emamectin benzoate) from the initial stage of cultivation as reported by the farmer. In addition to this, appropriate sanitation measures like removal of infested plant parts and host plants like *Solanum nigrum*, etc was practiced resulting in lesser number of *T. absoluta* than in other farms.

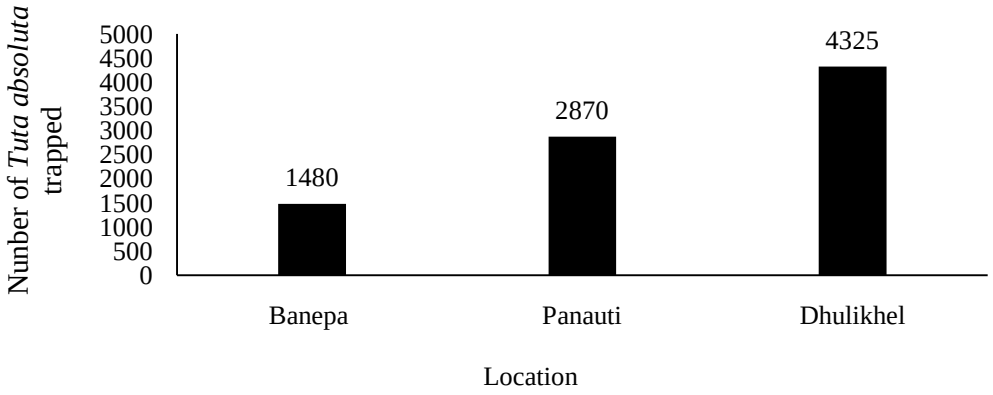
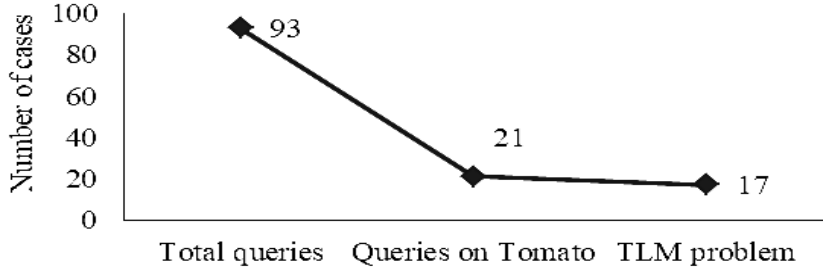


Fig. 2 : Total number of *T. absoluta* trapped in three locations of Kavre from June- August, 2017

Monitoring *T. absoluta* cases through plant clinic

Plant clinic data from four regular E-plant clinic conducted on monthly basis at Panchkhal, Kavre from April-July, 2017 revealed the severity of *T. absoluta* in which 17 cases were reported on *T. absoluta* out of total 21 cases on tomato crop (Figure 3). Information from plant clinic showed that this insect was causing havoc in the area near plant clinic location at Panchkhal, Kavre district.



Source: Plantwise, 2017

Fig. 3 : Cases of *T. absoluta* in E-plant clinic in Kavre from April - August, 2017

Farmer's survey on *T. absoluta*

Status of T. absoluta

Although this is new invasive pest in Nepal, all the tomato growers in surveyed area had idea regarding the presence of *T. absoluta* while only 26% had knowledge on its life cycle and majority of the respondent could identify its larva (60%) and adult (58%). Forty six percent of them reported flowering and remaining 54% reported fruiting as most susceptible stage to *T. absoluta* attack.

About forty six percentage of respondent became familiar on *T. absoluta* from friends/progressive farmers around their locality followed by Agrovet (30%), District Agriculture Development Office /Agriculture Service Centre (20%) and 4% from INGO/NGO.

Majority of tomato growers (78%) ranked *T. absoluta* as the most problematic in cultivation of tomato crop (Figure 4).

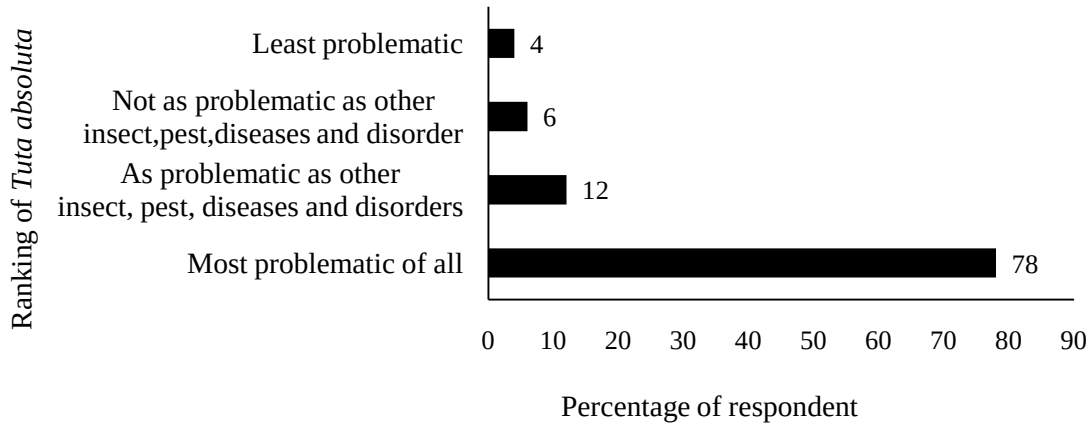


Fig. 4 : Ranking of *T. absoluta* out of many other problems in Kavre, 2017.

Out of total respondents, 38% reported very high (40% and above), 34% reported high, 16% reported medium (10-20%) and 12% reported low (0-10%) yield loss due to this pest in 2017. Higher yield loss of tomato due to this pest was reported in the study area (Figure 5) which was similar to results of Nigeria where *T. absoluta* destroyed 80% of tomatoes in 2016 (Poudel, 2017). Similarly, Joshi *et al.* (2017) estimated 57.51% of yield loss of tomato crop in Kavre due to *T. absoluta*.

Management practices for T. absoluta in Kavre

Study revealed that different management practices such as cultural, physical, mechanical, chemical attractants, botanicals, chemical pesticides and quarantine measures were adopted by the tomato growers. Biological method of pest management was not practiced by any of the farmers due to lack of availability and technical know-how.

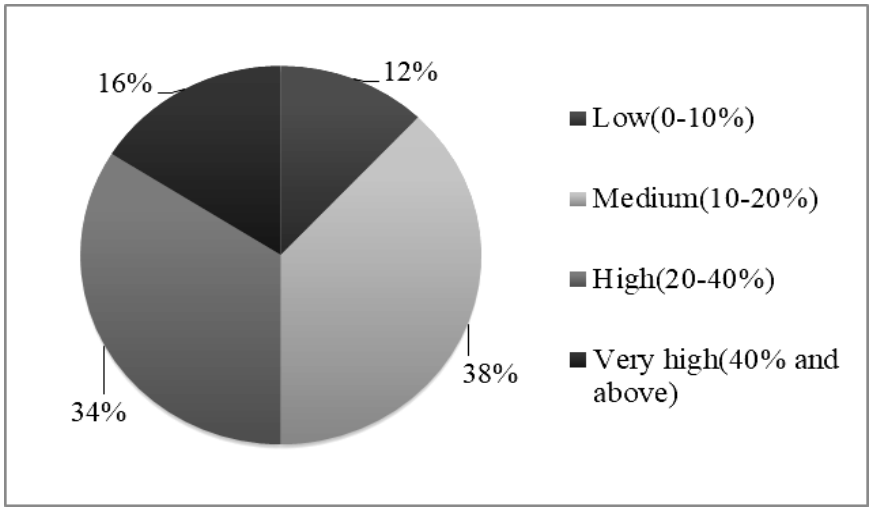


Fig. 5 : Yield loss by *T. absoluta* in 2017, Kavre.

Among the respondent farmers, 94% used chemical pesticides, 86% followed cultural practices, 66% used TLM Lure, 34% followed quarantine measures, 32% used botanical pesticides, 28% followed physical, and 28% followed mechanical methods for the management of *T. absoluta* (Figure 6). Similar result was reported by Joshi *et al.* (2017) that 89 percent of respondent used chemical pesticide in Kavre. Maximum number of tomato grower used chemical pesticide because of its effectiveness and easiness to use.

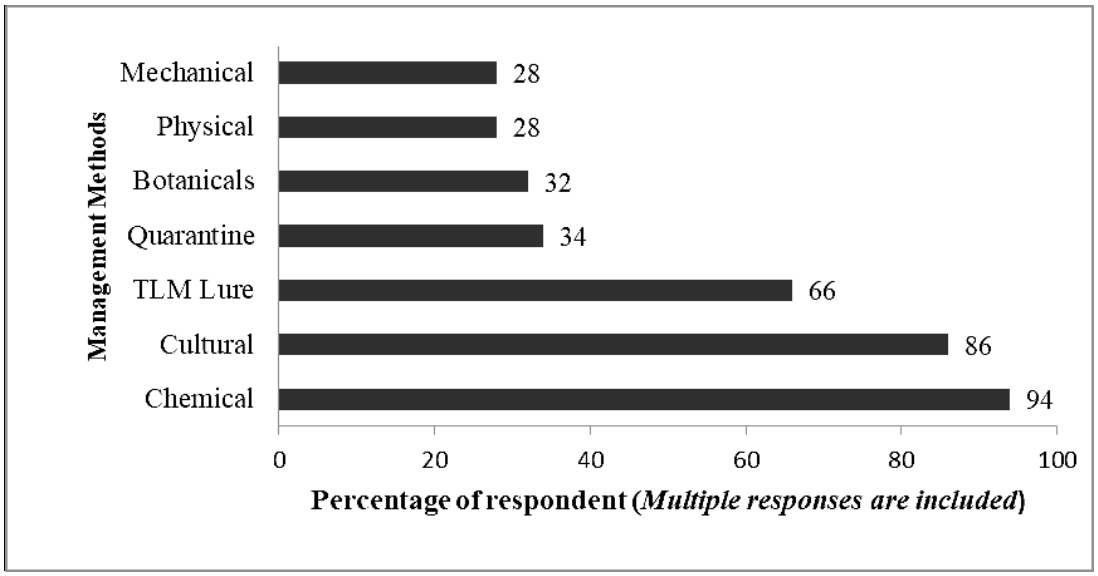


Fig. 6 : Different management practices adopted for management of *T. absoluta* in Kavre, 2017

Regarding cultural methods, 81.4% of the respondent removed the infested plants parts, 16.3% followed crop rotation and rest 2.3% removed the host plants like *S. nigrum*, etc whereas 50% of the respondent followed hand picking of the larva, 28.6% used yellow sticky trap, 21% used pest exclusion nets under mechanical methods (Table 1).

Table 1. Use of different cultural and mechanical methods to control *T. absoluta* in Kavre, 2017

Cultural methods	Number (Percent)	Mechanical methods	Number (Percent)
Removal of infested plant parts	35 (81.4)	Hand picking of the larva	7 (50)
Removal of host plants	1 (2.3)	Use of insect exclusion net	4 (28.6)
Crop rotation	7 (16.3)	Use of sticky traps	3 (21.4)
Total	43 (100)		14 (100)

Note: Figure in parentheses indicate percent

In chemical methods of management of *T. absoluta*, Table 2 represents that 27.66% of the respondent used Emamectin benzoate (trade name EMAR and King Star) whereas 21.27% used Chlorantraniliprole (trade name Allcora and Coragen). Similarly, 14.89% used Chloropyriphos and Cypermethrin (trade name King Killer and Aver Top) and 6.38% used Spinosad (trade name Tracer), 4.26% percent used Novaluron in Kavre to control *Tuta absoluta*. Likewise, remaining 25.54% of respondents used chemical pesticide but they could not answer the name of the pesticide. Similarly among botanical pesticides, 43.7% used commercially available Neem *(*Azadirachtin*)* based insecticides, 18.7% used locally made "Jholmol" (prepared from "Asuro" *Adhatoda vascica* , "Tittepati" *Artemisia vulgaris*, "Chilli" *Capsicum annum*, "Bojho" *Acoromus calamus*, garlic cloves etc. About 31% used DADA guard plus (Panna International, West Bengal, India) (ingredients- Clove, Garlic, Neem, Karanja oil and Garlic extract) whereas 6.3% used Lava plus (Greenland Bio-Science, India) both are claimed as a natural plant based extract by manufacturing company. According to Joshi *et al.* (2017) tomato growers have used Emamectin benzoate (EMAR and Kingstar), Chlorantraniliprole (Allcora), Cyromyzine (King Hunter) and botanical pesticide like DADA Guard for the management of *T. absoluta*.

Table 2. Different chemical and botanical pesticides used to control *T. absoluta* in Kavre, 2017

Chemical pesticides	Number (Percent)	Botanical pesticide	Number (Percent)
Chlorantaniliprole	10 (21.27)	Neem based pesticide	7 (43.7)
Chloropyriphos and Cypermethrin	7 (14.89)	Jholmol	3 (18.7)
Emamectin benzoate	13 (27.66)	DADA Guard plus	5 (31.3)
Novaluron	2 (4.26)	Lava plus	1 (6.3)
Use but could not answer the pesticide name	12 (25.54)		
Total	47 (100)		16 (100)

Note: Figure in parentheses indicate percent

Among quarantine measures, 63.2% of respondents avoided the transport of tomato seedling from other places, 21% avoided the transport of tools from one place to another and 15.8% adopted the both measures whereas all tomato growers used light trap under physical methods (Table 3).

Table 3. Use of different quarantine and physical methods to control *T. absoluta* in Kavre, 2017

Adoption of internal quarantine measures	Number (Percent)	Botanical pesticide	Number (Percent)
Avoid transport of seedling from one place to another	12 (63.2)	Physical methods	14 (100)
Avoid transport of tools or farm equipment from one place to another	4 (21)		
Both	3 (15.8)		
Total	19 (100)		14 (100)

Note: Figure in parentheses indicate percent

Comparative overview of different management practices

The most economic method was cultural as reported by 50 tomato growers followed by botanical (35) and para-pheromone trap (32) while the most effective method was chemical pesticide (42) followed by para-pheromone trap (40). All management practices except chemical pesticide was found safer. Para-pheromone trap (43) followed by chemical method (35) was the most practicable while para-pheromone trap (41) followed by botanical (40) and cultural method (39) was the most easily available methods. Use of para-pheromone trap was found as the best in almost all criteria of management method.

Table 4. Comparative overview of different T. absoluta management practices in Kavre, 2017

Management methods	Criteria				
	Economic	Effective	Safe	Practical	Locally available
Cultural	50	7	50	17	39
Mechanical	22	7	50	10	30
Physical	20	30	50	19	15
Botanical	35	34	50	30	40
Chemical	7	42	5	35	34
Para-pheromone trap	32	40	50	43	41

Note: The above figure indicates number of respondents with maximum value being 50

CONCLUSION AND RECOMMENDATION

The population of *T. absoluta* trapped in weekly interval during June-August, 2017 ranged from 51 to 972 per Wota -T trap. Majority of tomato growers relied on chemical pesticide followed by cultural practices and para-pheromone traps. Though sustainable management measures have not been practiced, focus should be given on integrated use of all the available management practices including physical, cultural, mechanical, biological and chemical methods to limit the significant loss and dependence on chemical pesticides in future. Use of pesticides in a correct way is essential.

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