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Research Article

OCCURRENCE OF SOUTH AMERICAN TOMATO LEAF MINER (*TUTA ABSOLUTA)* AND CURRENT MANAGEMENT PRACTICES ADOPTED BY FARMERS IN LALITPUR DISTRICT, NEPAL

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ABSTRACT

A study was carried out to document occurrence of *Tuta absoluta* and current management practices adopted by farmers in Lalitpur district (Lele VDC) where a total of 70 respondents were interviewed using random sampling method. The study comprises three target groups viz. structured questionnaire survey of farmers growing tomatoes (50); structured questionnaire survey of traders involved in tomato business (10); and lastly farmers' field survey to determine the extent of *Tuta absoluta* damage in leaves (10). The results revealed in the field *Tuta absoluta* is the most devastating insect pest and has done the highest 72% losses in the farmer field which is the heavy loss for the farmers and as a result, production of tomato has decreased in 2016 as compared to 2015. However while all the respondents claimed to have faced pest problem only 20% of the respondents were aware about *Tuta absoluta*. The survey also showed that 70% of the respondents were using para-pheromone lure (TLM lure) while 10% were using para-pheromone lure + light trap, 60% were using botanicals and bio-pesticides like Neem, Bacillus Thuriengensis in alternative ways and 20% were using chemicals like Chlorantraniliprole 18.5% SC (Alcora), Botanical pesidides (Dadaguard), Emamectin benzoate (EMAR 5% WDC), Cyromazine 10% SC (King hunter), Flubendiamide 39.35% SC (FAME 480 SC) without considering their environmental and health risks. All recommended *Tuta absoluta* control strategies such as pheromone trapping for monitoring as well as suppression, chemical and biological control were not available or known by growers. Trader's survey showed on an average of 11.7 percent of fruits damage in market where as in farmers field survey revealed an average of 3 percent loss in net house and 10.3 percent loss in open field.

Key words : Biological,Chemical, Management practices, para-pheromone, *Tuta absoluta*

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INTRODUCTION

Nepal is an agriculture-based land locked country where more than 54% population is engaged in agriculture and one-third GDP contributed to the nation (ADS, 2016; NPC, 2016).The total cultivated area is 3.09 million hectares (CBF, 2009-10). Similarly, the total area of vegetable cultivation of Nepal is 254932 ha with the production of 3421035 mt. Solanaceous vegetable constitutes the major group 13.57 per cent in the vegetable produce of the country. The largest share of cultivation area in solanaceous vegetables, tomato is 49.9 % followed by peppers25.95 % and brinjal 24.13% (ABPSD, 2013/14). Tomato (*Solanum lycopersicum* Mill.) is one of the most important vegetable crops in Central Asia (FAO, 2017). Tomato is native of Western South America. It is grown for fresh as well as for processing. Due to its wider adaptability it is cultivated under various agro-climatic conditions of temperate, tropics and sub-tropics.

In Nepal, tomato is one of the important crops used as fresh vegetable as well as the poor man's apple(Ghimire et al.2017) is ranked prior to other vegetable crops. In Nepal, tomato is grown in 20046 ha area with a production of 386824.6 mt. with an average production of 19.3m/ha(ADS, 2016). Kathmandu, Lalitpur and Bhaktapur are the most important tomato growing district (ABPSD, 2013/14). The increase in area under tomato cultivation in these districts has brought change in social as well as economic conditions of the farmers. The area under tomato of Kathmandu district is 210 ha and total production of tomato is 2025 mt. The area under tomato crop of Lalitpur district 138 ha and total production is 4140mt. The area under brinjal crop of Bhaktapur district is 152 ha and total production is 8360 mts. (ABPSD, 2013/14). The gradual and ever-increasing year-round demand of tomato for fresh consumption and processing resulting from increasing urbanization, hotels, tourism, nutritional awareness of the people, etc. is making avenue to the off-season production (Chapagain *et al.*, 2012). Tomato production during rainy season in open field condition is very difficult and the production during the season is very low (Pandey and Chaudhary, 2004). However, the difficulty is overcome by the new and modest technology of tomato production inside the plastic house and arrival of hybrid varieties (Chapagain *et al.*, 2012). Farmers face many kind of problems in the field, among them pest (disease, insects, weeds, etc.) are the important one.

Tomato production is constrained by numerous insect pests and diseases. Among these, an ongoing threat for its yield is South American tomato leaf miner, *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) which has recently become a serious threat to tomato production and has been spreading in rapid manner. South American tomato leaf miner, is devastating pest of tomato (*Lycopersicon esculentum* Miller) and species of Solanaceae crops (EPPO 2009; Viggiani *et al., 2009;* Speranga, 2009; Tropea Garzia, 2009),. Each female may lay up to 300 creamy colored eggs and 10-12 generations can be produced each year. In tomato, it can attack any plant part at any crop stage and can cause up to 80-100% crop destruction, although the larvae prefer apical buds, tender new leaflets, flowers, and green fruits. This invasive moth is one of the most serious pests of tomatoes, causing up to

80-100% crop loss (CABI, 2011/13; Desneux *et al.* 2011). It also affects other solanaceous crops, such as potatoes, peppers, and eggplants (EPPO 2009i; Pereya and Sanxhez 2006) . *T. absoluta* has been key pest of tomato in the South American region since 1960s and was reported in Spain in 2006 and subsequently spread throughout many European and Mediterranean countries. The pest had been reported from Turkey in August 2009 and from Iraq in 2010. It has been recorded from Maharashtra (India) during October, 2014. Since its introduction to India, the possibility of invasion of Nepalese's tomato farming by the pest was always existed due to open border, weak quarantine and import of tomato from India (Bajracharya *et al.,* 2016).

This pest is crossing borders and devastating tomato production in both protected and open fields. Given its aggressive nature and crop destruction potential, it has quickly become a key pest of concern. *T. absoluta* has been reported in a tomato farm during the first quarter of 2016, farmers from Kathmandu, Bhaktapur and Kavre Districts for the first time in Nepal (Bajracharya *et al.* 2016). Similarly, the team from Integrated Pest Management- Innovation Lab IPM-IL and others visited the sites and collected samples. *T. absoluta* lures from Pest Control India were also placed in the infested fields. The number of insects trapped in pheromone traps, their external morphology and damage symptoms all indicated *T. absoluta*. Samples of adult moths and larva were sent to the School of Life Science, Arizona State University. Laboratory tests confirmed the new pest was *T. absoluta*. The presence has been confirmed in five districts, Kathmandu, Lalitpur, Bhaktapur, Kavrepalanchowk and Dhading. Studies carried out by the Nepal Agricultural Research Council (NARC) in May and June of 2016 identified and confirmed the presence of the pest in 14 locations in the five districts mentioned above Bajracharya *et al.* (2016). The highest infestation was identified in two districts; Ugrachandi Nala-2 and Panchakhal of Kavrepalanchowk district (Bajracharya *et al.,* 2016; Joshi *et al.,* 2017).

T. absoluta is now has spread in devastating form throughout the tomato growing areas in country and has become a key yield limiting factor in tomato. The use of pesticides in unscientific way has dangerous consequences to man and environment and hence necessitated the search for the development of ecologically sustainable control methods for the effective control of this pest. The present research work is undertaken with the objective to know the incidence of *T. absoluta* of tomato in Lalitpur District. This research is helpful to provide the best management tactics adopted by the farmers in that area. The result obtained from this study will help minimize the use of chemical pesticides to control the pest so that it obviously will help to improve the soil health, consumer's health and environment quality thus enhancing better production. Also this study would help the farmers to know about the nature of pest it's mechanism of spread and management techniques.

MATERIALS AND METHODS

The study was carried out in Lele VDC of Lalitpur District from January 24th to April 20th, 2017. A total of 70 respondents participated in the research and were selected by using random sampling method. The study comprises three target groups viz. structured questionnaire survey of farmers growing tomatoes; structured questionnaire survey of traders involved in tomato business; and lastly experiment in farmer's field was also carried out to determine the extent of *T. absoluta* damage in leaves. Both primary and secondary data were collected from field and various reliable sources were analyzed during the study period. Farmers growing tomatoes in Lalitpur district esp. Lele VDCs were the major sources of the primary data. This data were collected by directly interviewing the respondents, traders with the pre-tested semi structured questionnaire.

For secondary information various published and unpublished sources such as related journals, books, reports, and unpublished reports were reviewed. For supplementary information organizations like NARC and DADO were visited. Ministry of Agricultural Development (MOAD), Nepal Agricultural Research Council (NARC), District Agriculture Development Office (DADO), Central Bureau of Statistics (CBS), Agriculture Information and Communication Center (AICC), Agro-Enterprise Center (AEC), iDE Nepal, Institute of Agriculture and Animal Science (IAAS), Nepal Polytechnic Institute (NPI) and different websites were also visited for secondary information.

With regards to experiment in farmer's field, 10 farmers growing tomatoes in a *Tuta absoluta* infested region were surveyed to determine the extent of damage caused by *Tuta absoluta.* Farmers field with tomato plants at flowering and fruiting stage were selected for the experiment. At least 10 tomato plants were selected and tagged in each farmer's field. Tomato plants were selected in 'Z' shaped pattern. Then the number of damaged shoots, leaves and fruits were counted and recorded.

The information obtained from the survey was coded first and entered into the computer. Descriptive statistics like mean, percent and frequency were used to describe economic status and farm characteristics. Data entry and analysis was done by using computer software package "MS Excel 2013". Analyzed data was then presented in tables, graphs and pie-chart.

RESULTS AND DISCUSSION

Demographic profile of the respondent farmers

The age group of 16-60 was economically active age group. Majority of the farmers were female (88%) because most of the male members were either involved in other occupation or been to abroad. Education status 38 percent respondents were illiterate and 52 percent were just literate, primary level farmers were of 6 percent and secondary and above were of 4 percent.

This lack of education also reflected on the farmers awareness level regarding pest as the survey found that 20 percent of respondents in the study area were aware of the pest while

70 percent of them had poor knowledge on the pest and were causing major loss in the field where as 10 percent of them had completed standard seven, own cellphone for exchange various information related to market and control of various field pest in their tomato fields including leaf miner.

Status of *T. absoluta* in the study site

In the field *T. absoluta* is the most devastating insect pest and is the major problem in tomato fields currently. When plants from heavily infested field are shaken, adult moths found flying near to ground surface. The survey also showed that all the farmers who were interviewed had *T. absoluta* in their field and seems to have caused 80 percent to 100 percent of the crop loss in absence of management practices. As a result, the insect pest has impacted the production of tomatoes as revealed during the field survey when comparing the production of tomatoes in 2015 and 2016 (Figure 1) the production of tomatoes is high before the outbreak of *T. absoluta* in 2015, but there is decrease in production in 2016 due to incidence to *Tuta*in the farmers' field. Similarly the survey results from Bajracharya *et al.* (2016) and Joshi *et al.* (2017) revealed that all major tomato growing areas surveyed in Kathmandu, Lalitpur, Bhaktapur and Kavrepalanchowk district showed presence of the South American tomato leaf miner. The survey results from Joshi *et al.* (2017) revealed that loss in yield due to *Tuta*was majorly seen in Kavre, Lalitpur, Bhaktapur and Kathmandu were 57.51, 50, 47.16 and 42.3 percentages, respectively. Majority of the farmers were hit by the pest damaging tomato worth lakhs.

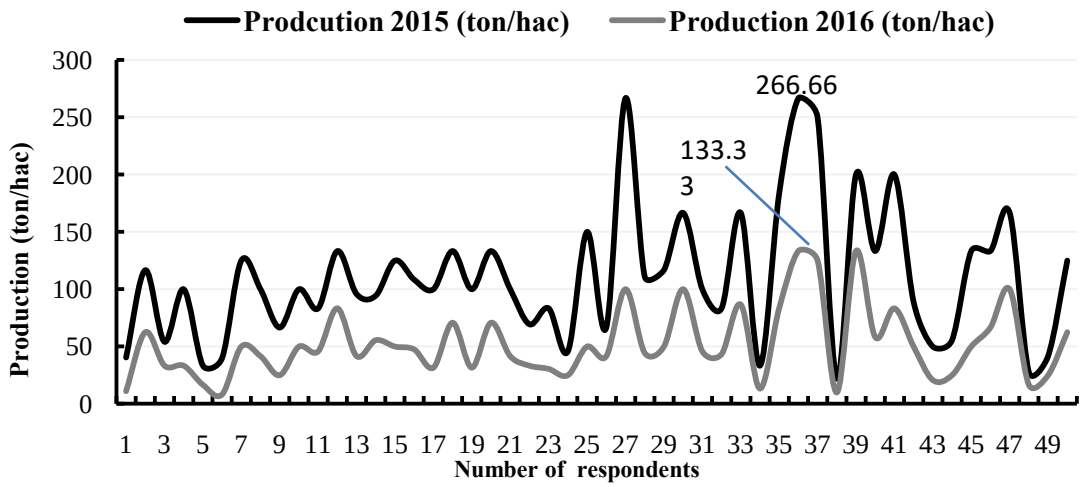

Fig. 1 : Production comparison from two years (2015 and 2016)

Similarly, the loss percentage for the same period (2015 and 2016), we could see that losses are higher in 2016. Loss varies from 32 percentages to 72 percentages in 2016 and this loss is mainly because farmers were unaware of this new pest and were unknown of the

management practices that need to be adopted to control the pest. Likewise, in 2015 maximum loss occurred was 20 percent and minimum loss was 3 percent. As shown Figure 1, the difference of losses occurred in 2015 and 2016 i.e. before and after the outbreak of *T. absoluta* in Lalitpur District (Lele VDC).The study done by Joshi *et al.* 2017 revealed that the highest yield loss (57.8%) was found in Kavre where only 11 percent of the growers used chemical pesticides and biopesticides in an integrated way. Yield loss and integrated use of chemical pesticides and biopesticides were intermediate in Lalitpur and Bhaktapur districts.

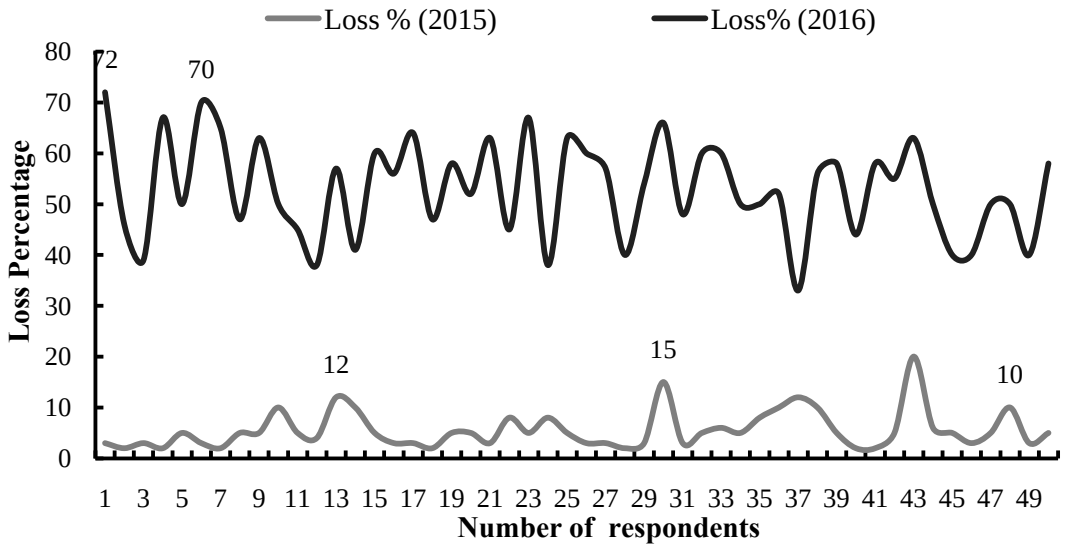

Fig. 2 : Loss percentage comparison from two years (2015 &2016)

Percentage of fruit damage by *Tuta absoluta* in market of Lalitpur

Ten traders of study areas were surveyed. 200 tomatoes were taken per trader randomly and damaged fruits were selected in order to know the damage percentages of fruits in market. The survey study showed 11.7% fruits damage in the market on an average which is low but the reason behind this is the new pest *Tuta* according to the traders. According to the survey most of the traders imported tomato from Dhading, Kavre, Panchkhal and similarly other imported from Kalimati, Galchi, Nuwakot, Trishuli, Chitwan. The market price of tomato has also been increased compared to previous year due to low production because of higher incidence of *Tuta* in field. Damaged fruits usually go to the hotels or they throw it without any proper disposal of damage fruits.

Table 1. Percentage of fruit damage by *T. absoluta* in Market of Lalitpur

SN	Total no. of fruits observed	No. of fruits Damaged by *Tuta absoluta*	Percent of damage	Damage Level	Imported From
1	200	26	13%	Low	Kavre, Panchkhal
2	200	22	11%	Low	Dhading, Galchi, Nuwakot, Trishuli
3	200	30	10%	Low	Dhading, Salanghat
4	200	29	15%	Low	Chitwan, Dhading, Kavre
5	200	20	10%	Low	Panchkhal,Dhading
6	200	15	8%	Low	Kalimati, Pachkhal, Dhading
7	200	18	9%	Low	Dhading, Bhaisepati
8	200	26	13%	Low	Kalimati, Pachkhal
9	200	32	16%	Low	Kavre
10	200	23	12%	Low	Dhading
	Average	24.1	11.7	Low	

Severity: Low: 1-25%, Medium: 26 - 50%, High: >51% (Field Survey 2017)

Percentage of leaf damage by *T. absoluta* in field

Ten plants were observed randomly in Z pattern and the damage leaves were noted to find the damage percentages in both open field and net house. In net house on an average 775.4 leaves were observed percentage of leaf damage in the net house which shows damage level low (3%). Similarly, in open field on an average 607.6 leaves were observed and 10.3 percent of leaves were found to be damaged which is higher than the damage in net house. This study was undertaken to compare the leaf damage of net house and open field the damage percentage is higher in open field compared to the net house. According to the severity level damage percentages is low because farmers there were using chemicals like Chlorantraniliprole 18.5% SC and Spinosad 45% SC@1ml/litre by consulting the Agro vets near them to control the pest. However, the entry of the pest to the net house may be due to the movement of people and its pupation in the soil.

Management practices adopted by farmer at study site

According to the survey majority of farmers 70 percent were using para-pheromone TLM lure (PCI, India). While 10 percent were using pheromone lure and light trap at the same time and 60 percent were using bio-pesticides and botanicals like *Jholmol* and *Azadirachtin* as the management practice to control *T. absoluta*. In the study area, about 20 percent farmers were using chemical pesticide such as Alcora (Chlorantraniliprole 18.5%SC), Emamectin benzoate 5% WDG, Dadaguard, and FAME (Flubindamide 39.35%SC to control *T. absoluta* in severe cases.

The study done by Joshi *et al.* (2017) revealed that the farmers were adopting different types of method for the management of *T. absoluta* like chemical or / and bio- pesticide (including

botanical pesticides), pheromones, light trap and net houses. Majority of the respondents (89%) in Kavre were using chemical pesticides whereas respondents using chemical pesticides were about 35 percent, 45 percent and 31 percent in Kathmandu, Bhaktapur and Lalitpur districts, respectively. Around 55 percent, 40 percent, 43 percent and 11 percent of respondents at Kathmandu, Bhaktapur, Lalitpur and Kavre districts, respectively used chemical pesticide (ChP) and biopesticides (BP) in an integrated way for the management of *T. absoluta*. While 7 percent, 12 percent, 9 percent were using ChP, BP and mass trapping methods (MTM) in Kathmandu, Bhaktapur and Lalitpur, respectively.

Thapa *et al.* (2015) reported that farmers were found to be relied on pesticides from bedding of plant till harvesting to control pests. As the farming of tomato were done totally by the use of pesticides (Palikhe 2002, Shrestha 2001). Farmers used pesticides to increase productivity and to kill the pests so that more profit and high yield can be achieved (Thapa *et al.* 2015; Palikhe 2002). Even though they bought the pesticides directly from shop or agro-vet dealer and used that according to the label in containers or according to shopkeeper. Lack of knowledge about pesticides, its composition and its formulation made more misuse of pesticides.

Palikhe (2002) documented that misuse and overuse of pesticides, particularly among commercial farmers, posed a health risk to the public and have numerous cases caused serious poisoning. The illegitimate used was due to unawareness of toxicity, aggressive marketing by dealers and profit interests. Many farmers did not understand the instructions written on the pesticide labels. The harmful effects of pesticides have been experienced by farmers and their families. There was a higher risk of presence of pesticides residue in vegetables which poses higher health risk to vegetable growers as well as consumers. Shrestha (2001) reported that overuse of synthetic pesticides has also resulted in pest resistance to pesticides, resurgence of pests, elimination of natural enemies and disruption of ecosystems. There is, therefore, a need for alternative pest control measures for both commercial farmers currently overusing pesticides and food insecure subsistence farmers living at the mercy of pests. A healthy, effective and lasting mechanism for plant protection is required for food security, food safety, poverty reduction and rural development (Shrestha *et al.*, 2010).

CONCLUSION

The study showed that there were many insect pests attacking different parts of tomato like South American tomato leaf miner, tomato fruit worm, aphids, whitefly, white grubs, etc. Among them incidence of South American tomato leaf miner (*Tuta absoluta)* was high causing economic loss in this recent year. From the current study it was found that the farmers had very little knowledge about the specific pest so; they were facing great challenge in their management. Management of *T. absoluta* has so far relied on calendar-based application of a wide range of pesticides along with the use of some traditional methods. Hardly any pest monitoring techniques are used in the study area to adjust

pesticide applications. A shift from current pest management strategies is thus necessary An IPM strategy that adopts a holistic approach at the agro ecosystem level, rather than concurrent piecemeal pesticide applications, is likely to enhance the control of *T. absoluta* and other pests, such as the several Noctuidae species, which also cause considerable yield loss within these agro ecosystems.

There should be focus on the community awareness to tomato growers for proper *Tuta absoluta* management, use of appropriate safety precautions while use of chemical pesticides and its side effects on public health and environment. Therefore there is required to study on the existing control practices for managing this pest, effectively for tomato grower of Nepal. It is needed to educate more number of farmers to acquire new skills and knowledge to complement the existing practices and apply them to the farming. There is therefore an urgent need to train farmers and extension workers using appropriate Integrated Pest Management (IPM) approaches on *Tuta absoluta* management using farmers field schools (FFS) or other extension approach.

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