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Life cycle of *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) on different solanaceous host plants at laboratory conditions in Nepal

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Abstract

South American tomato leaf miner, *Tuta absoluta* (Meyrick, 1971) (Lepidoptera: Gelechiidae) is an oligophagus insect pest of tomato and has a high capacity to feed on various cultivated as well as wild plants as alternate hosts. Life cycle of the insect on alternate hosts are equally important to develop integrated pest management (IPM). Considering this fact, life cycle of *T. absoluta* on three solanaceous plants: tomato (var. Srijana), potato (var. Kufri Jyoti) and brinjal (var. Shamli hybrid) was studied at laboratory conditions during October- November, 2018. *T. absoluta* successfully completed life cycle on all three host plants. Tomato was found as the most suitable host of *T. absoluta* followed by potato and brinjal on the basis of developmental period and adult longevity. Mean larval period was found 10.75 days in tomato, 11.8 days in potato and 12.42 days in brinjal. Average pupal period of the insect was found 7.13, 7.66 and 8.00 days in tomato, potato and brinjal, respectively. The total developmental period from egg to adult emergence was found 21.87 days in tomato, 23.46 days in potato and 24.50 in brinjal. Adult moths survived longest on tomato (12.00 days) followed by potato (9.60 days) and brinjal (8.30 days).

Keywords: *T. absoluta*, host, brinjal, potato, tomato, developmental period

Introduction

South American tomato leaf miner, *Tuta absoluta* (Meyrick, 1997) is a devastating insect pest of tomato (*Solanum lycopersicum*, L.). This oligophagous invasive insect associated with solanaceous crop reduce yield and quality of tomato under heavy infestation. In newly invaded areas, 80-100% yield loss of tomato was reported both in the field and green house conditions when control measures were not applied^[8]. Larvae of the insect penetrate into leaves, stems, buds, fruits forming mines and galleries. Secondary infection from disease pathogens occur through the galleries formed by the larvae on fruits leading to fruit rot^[10]. *T. absoluta* was recorded for the first time in Nepal from Kathmandu in May, 2016^[5] and had been spread into 33 districts across hill and plain areas of Nepal^[4].

Tomato is considered as primary host plant of *T. absoluta* but had also been reported on other cultivated solanaceous crops: potato (*Solanum tuberosum* L.), egg plant (*Solanum melongena* L.), pepper (*Capsicum annum* L.), tobacco (*Nicotiana tabacum* L.), cape gooseberry (*Physalis peruviana* L.), pepino (*Solanum muricatum* L.)^[17, 7, 16]. The insect reported from non-cultivated solanaceous weeds like, black nightshade (*Solanum nigrum* L.), jimsonweed (*Datura stramonium* L.) and wild tobacco (*Nicotina glauca*)^[12, 13]. Broad bean (*Vicia faba*), cowpea (*Vigna unguiculata*), common bean (*Phaseolus vulgaris*) and alfalfa plant (*Medicago sativa*) of family Fabaceae, watermelon (*Citrullus lanatus*) of family Cucurbitaceae, physic nut (*Jatropha curcas*) of family Euphorbiaceae, spiny amaranth (*Amaranthus spinosus*) of family Amaranthaceae, ramtoucek (*Xanthium brasasicum*) of family Asteraceae and wild radish (*Raphanus raphanistrum*) of Brassicaceae were also reported as the alternate host of *T. absoluta*^[11, 16, 9, 2, 1].

This indicates that *T. absoluta* has high capacity to use various cultivated as well as wild plants belonging to different families as alternate hosts especially from Solanaceae family. During field visits within the country potato and brinjal plants were also found infested by *T. absoluta*. Life cycle of *T. absoluta* in tomato crop had been studied in laboratory conditions in Nepal. The average developmental period from egg to adult was found 18.37 days: average egg,

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larval and pupal periods was recorded 3 days, 8.26 days and 7.11 days, respectively [3]. Life cycle study on alternate hosts are equally necessary in order to develop ecological management of the insect pest which is indispensable part of integrated pest management (IPM).

Materials and methods:

Source of insect culture of *T. absoluta* was maintained in Entomology Division of NARC. Adult insects were reared in rearing cages made from insect proof net in wooden frames with dimensions of 47cm X 47cm X 77cm of length, breadth and height. Pesticide free fresh tomato shoots were provided for egg laying. 10 percent honey solution was provided as adult food. Eggs, a newly hatched larvae and pupae were kept in separate plastic boxes for rearing. Emerged adults were transferred to rearing cages for egg laying and continuous cycles of *T. absoluta* were maintained throughout the year.

Life cycle of *T. absoluta* was studied in three different solanaceous hosts: tomato (var. Srijana), potato (var. Kufri Jyoti) and brinjal (var. Shamli hybrid) at laboratory conditions in Entomology Division, NARC. The life cycle was studied during October to November 2018. Average temperature and humidity during the study period was 23.6 ± 2 °C and 46.29 ± 5 percent, respectively.

Newly emerged *T. absoluta* adults were kept in transparent plastic boxes of 250 ml capacity covering with black muslin cloth. Eggs laid on black muslin cloth were collected and kept in separate plastic boxes. Newly hatched larvae were released on fresh leaves of tomato, potato and egg plant. Single larva was released in each leaf and kept in glass petriplates of nine cm diameter. Leaves were kept above slightly moistened filter paper spread on the petriplates in order to protect from drying. Leaves of different host plants were changed daily in each plates. Larval exuvia were observed to determine moulting during transfer of larvae to fresh host leaves and the whole process was performed under a stereo microscope (Bestscope B S-3040T). Pupae were left intact in petriplates until adult emergence. Observation from 16 plates with tomato leaves, 41 plates with potato leaves and 29 plates with brinjal leaves were recorded which completed life cycle. After emergence, adults were transferred to transparent plastic boxes of 250 ml

capacity and covered with black muslin cloth. 10 percent honey solution was given as adult food spreading on muslin cover. Date of egg laying hatching and adult longevity were recorded from these adults. Data obtained from observations were entered in Microsoft excel mean values, ranges and standard error of means was calculated.

Results and Discussion

T. absoluta completed all four development stages viz. egg, larva, pupa and adult in tomato, potato and brinjal under laboratory conditions at 23.6 ± 2 °C temperature and 46.29 ± 5 percent relative humidity. Mean duration of various development stages in different hosts is given in Table 1. Egg constantly hatched in four days duration in laboratory conditions. Mean larval developmental periods were found 10.75 days in tomato, 11.8 days in potato and 12.42 days in brinjal. The ranges of larval developmental period was found 10-12 days in tomato, 10-15 days in potato and 12-14 days in brinjal. Average period of the first, second, third and fourth larval instar were found: 2.56, 1.94, 1.81 and 4.44 days respectively in tomato, 2.72, 2.26, 2.35 and 4.46 days respectively in potato, and 3.00, 2.46, 2.86 and 4.11 days respectively in brinjal. Average pupal period of the insect was found 7.13, 7.66 and 8.00 days in tomato, potato and brinjal, respectively. The total developmental period from egg to adult emergence was found 21.87 days in tomato, 23.46 days in potato and 24.50 in brinjal.

On the basis of results the longest larval, pupal and total developmental period from egg to adult emergence was found in brinjal followed by potato and tomato, respectively. Sridhar *et al.*, also found similar findings with the shortest developmental period in tomato followed by potato and brinjal, while studying comparative biology of *T. absoluta* in three solanaceous host plants [15]. They found larval, pupal and total life cycle of the insect: 7.95, 7.95 and 19.65 days respectively in tomato, 11.45, 9.55 and 26.1 days respectively in potato, and 14.3, 10.8 and 31.2 days respectively in brinjal [15]. Pereyra and Sannchez, also found larval developmental time was shorter on tomato (12.14 days) compared to potato (14.00 days) [14].

Table 1: Mean duration of various developmental stages of *T. absoluta* reared in different host in laboratory conditions.

Stages	Tomato		Potato		Brinjal	
	Duration (days)	Range (days)	Duration (days)	Range (days)	Duration (days)	Range (days)
Egg	4.00±0	4	4.00±0	4	4.00±0	4
Larva 1 st instar	2.56±0.13	2-3	2.72±0.13	2-4	3.00±0.09	2-4
Larva 2 nd instar	1.94±0.06	1-2	2.26±0.10	2-4	2.46±0.14	1-4
Larva 3 rd instar	1.81±0.10	1-2	2.35±0.11	1-4	2.86±0.15	2-4
Larva 4 th instar	4.44±0.13	4-5	4.46±0.15	3-6	4.11±0.11	3-5
Larval period	10.75±0.21	10-12	11.80±0.23	10-15	12.42±0.16	12-14
Pupal period	7.13±0.24	6-9	7.66±0.18	6-9	8.00±0.33	7-9
Developmental period	21.87±0.29	20-23	23.46±0.33	20-26	24.50±0.42	23-26
Adult longevity	12.00±0.56	7-16	9.6±0.34	6-12	8.3±0.51	5-9

In previous study conducted in Entomology Division, average egg, larval and total developmental period from egg to adult emergence of *T. absoluta* in tomato was found 3 days, 8.6 days and 18.37 days [3]. However, in the present study the average egg, larval and developmental period in tomato was found 4 days, 10.75 days and 21.87 days respectively. Pupal period was found quite similar, 7.13 days and 7.11 days in present and previous studies. The shorter egg, larval and total developmental period from egg to adult emergence in

previous studies was due to higher temperature and relative humidity (27 ± 2 °C and 75 percent). According to Barrientons *et al.* 1998, developmental cycle of *T. absoluta* depends on environmental conditions, average developmental time was 76.3 days at 14 °C, 39.8 days at 19.7 °C and 23.8 days at 27.1 °C temperature.

However, adult fed on tomato leaves survived longest (12.00 days) followed by potato (9.60 days) and brinjal (8.30 days) irrespective of sex in laboratory conditions. Similar results

with longest adult life span was found in tomato followed by potato and brinjal ^[15]. They found 14.9, 9.75 and 7.55 days male longevity and 18.10, 12.0 and 8.9 days female longevity in tomato, potato and brinjal, respectively.

In the study, tomato was observed to be most suitable host of *T. absoluta* followed by potato, and brinjal on the basis of the shorter larval period, the total developmental period from egg to adult emergence and longer adult longevity. From the study, it reveals that *T. absoluta* has wide host range among cultivated solanaceae crops. In the absence of tomato, it can survive in alternate host plants as the secondary host which allows the continuous existence in the absence of tomato throughout the year. Though, *T. absoluta* prefers tomato compared to other hosts, it can successfully complete its life cycle in potato and brinjal, this could cause a threat to potato, brinjal and other solanaceous crops becoming major pest in future.

Conclusion

T. absoluta has a wide host range within solanaceous crops and it can infest both potato and brinjal in absence of primary host tomato. The life cycle could be successfully completed in potato as well as in the brinjal although it takes longer period compared to tomato.

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